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GAS JOURNAL

LIGHT • HEAT • POWER • BYE-PRODUCTS

[Founded in 1849 as the "Journal of Gas Lighting."]

Vol. CLXII. No. 3131.] LONDON, MAY 16, 1923. [75th Year. Price 1s.

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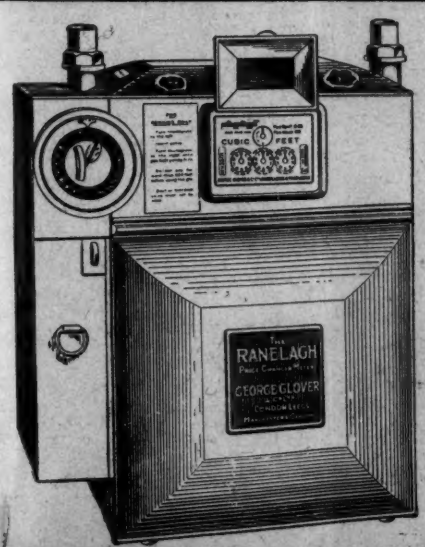

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VOL. CLXII., No. 3131.] WEDNESDAY, MAY 16, 1923. [75TH YEAR.

EDITORIAL NOTES.

Gas and the British Empire Exhibition.

THIS matter is occupying a large place in the minds of those responsible for the work of our central organizations. As is now well known, a meeting has been held at which it was resolved that the industry should be represented at the exhibition. A committee is being appointed, the members of which associated with the gas-supply industry have been selected; the names of those to represent the Society of British Gas Industries have not yet been published. At the moment the Society are desirous of securing more information as to certain matters. It is generally conceded that the gas industry should be in evidence at the exhibition. On this point there should be no two opinions, in view of the decision of the electricity industry to make a large demonstration at Wembley, the preparations for which are already well advanced.

The decision of the gas industry to exhibit is one thing; the form of the exhibit is another. There are various considerations that are worth keeping well in mind in this regard. In the first place, it would be impossible for manufacturers individually to keep stands going and representatives in attendance month after month. Therefore, it seems to us that the first matter that should be determined when the Committee meet is as to whether or not the gas exhibit should be a joint one; and, if so, the resolve should be that it should be on an impressive scale. It is no use making a niggardly display; nor is it necessary for a demonstration of the activities of the industry to be carried out on extravagant lines. Assuming a joint exhibit is agreed to, then the next consideration would be as to whether or not it should be confined to the utilization of gas, or include the productions of the manufacturers of gas plant and appliances, together with photographs and drawings. First thoughts suggest that it would be much better to confine the display to a big demonstration of the applications of gas and the bye-products of its manufacture. It has never yet been possible to bring together a truly representative collection of gas-manufacturing plant and the associated processes, simply because of their bulky nature and variety. And photographs and drawings of work done do not appeal to the public; they are rather repressive than impressive to those who are not technically concerned. The inclinations of the public in connection with exhibitions are distinctly towards those things in which they are personally interested; and in the modern use of gas and other products of coal carbonization, industry and the public generally are very intimately concerned. Some manufacturers of heavy gas plant do not sufficiently appreciate how much they depend upon the development of the utilization of gas. The enlargement of the demand for gas is the very source of the extension work that they obtain. If the demand for gas ceased to extend, and simply stood still, manufacturers of gas plant would have nothing left but renewal and repair work; the outlook for them would become very poor. There is not much possibility of this; but the more the gospel of gas utilization is preached, the more the ocular demonstration of what gas can do, the better for us all. We want the public who go out to see what is going on in the world in the way of material progress to learn of the very best that can be done in the applications of gas to heating, cooking, hot-water supply, and industrial uses—including power, furnace heating, and steam-raising—and to receive a lasting impression of utility, economy, and efficiency; for in this lies the expansion of our industrial prosperity. We do not know what other people will think of this suggestion. It is only a suggestion, and subject to any considerations of which we may not have thought; but our present view is that utilization is the matter upon which, at an exhibition of this kind, there should be concentration.

At the dinner of the Society of British Gas Industries last Thursday, the President of the National Gas Council (Mr. D. Milne Watson) emphasized the fact that here is an opportunity for the industry to show in a material form their great belief in unity; and he urged that, whatever is done, it should be worthy of the industry. Given that, there can be no doubt as to a success which would mean a material contribution to the movement of the industry in occupying more and more territory.

Maintenance Costs of Continuous Verticals.

THE question of the maintenance costs of different systems of coal carbonization is one of considerable importance in the economics of gas production. Generally speaking, when the continuous vertical system came into the manufacturing arena, visions of high maintenance costs relatively to those to which one had become accustomed with previous types of plant and methods of working soon began to find expression in discussions of the subject, without due allowance being made for the workings of experience in modifying those costs. Now, with the improved methods of construction, experience is establishing continuous vertical retorts in excellent place in respect of maintenance costs comparatively with other systems. The subject was introduced to the members of the Manchester District Institution of Gas Engineers, at their meeting in Liverpool last Friday, by Mr. W. Buckley, of the Droylsden Gas-Works of the Manchester Corporation. We are writing before the report of the discussion reaches us; and therefore we cannot say here the lines which comment upon the paper took. But it is anticipated that the figures given will be subject to a good deal of criticism. At the same time, Mr. Buckley made it abundantly clear that the costs should be taken not in any way to represent anything of a normal character, but merely as actual figures found under the specified conditions. Throughout, those conditions were of an adverse order to the system and to maintenance; and we submit that they can only be looked upon as interesting in the circumstances of this particular installation, and of the times to which they refer. There is little, if anything, in them that can be regarded as normal, or as applying to normal conditions, or to modern continuous vertical structures, with the experiences of the last thirteen or fourteen years incorporated in them. In the first place, the settings were among the first erected under the Glover-West system; and for this reason they were located at the Droylsden works, which are looked upon as the experimental station of the Gas Department. Being more or less an experimental installation, certain of the charges for maintenance are due to improvements. As Mr. Buckley says: "Being the first of its kind, the "installation naturally contained most of the shortcomings "inherent in a new plant of whatever type." Then the period covered by the data runs from July, 1910, to May, 1921—during about two-thirds of which period high costs

for material and labour prevailed, and so everything was dead against low maintenance costs. Allowance for the period of heavy costs will therefore have to be made in any attempt to assess the value of the figures as a guide in this particular matter of maintenance. Moreover, we think there will be some question as to whether or not certain of the items that Mr. Buckley has charged as "maintenance" should not be reckoned as running expenses. More as to this presently.

The paper is so full of detail that it is impossible to review it step by step in an editorial comment; and therefore those interested will turn to the author's contribution to obtain a more perfect appreciation of the conditions under which the expenditure was incurred. Being settings of the original type, they of course had their ups and downs in the early days. The charges due to this go to swell the maintenance account. Again, we have in this plant separate coal and coke elevators; and the plant for the latter has much idle time, and, with its exposure to the weather, its condition is not improved. In modern practice, the capital expenditure on coke-elevating plant has been eliminated; and one conveyor handles both the coal and the coke that has to be elevated. This helps to average-down the costs on the combined work. But to the actual figures. During the period mentioned—1910-21—the quantity of coal carbonized was 99,297 tons; and the average yield of gas was 13,240 c.ft. per ton. At the end of the paper, there is a summary of the maintenance costs per ton, the items of which are given in the paper. They work-out to 10·613d. per ton of coal carbonized, or 0·801d. per 1000 c.ft.

Taking the items individually, there is first 0·390d. per ton for maintenance and repair of gas-engines, which dealt with 175,424 tons of coal and coke during the period. In this, there is included gas-engine oil (about 1150 gallons) £93 2s. This, it seems to us, should properly be a running charge, and not a maintenance expense. There may, however, be a difference of opinion regarding this. The next charge is 0·461d. per ton for the maintenance and repair of the coal-elevator. Then we come to a charge of 0·693d. per ton for gas used by large engine for breaking and elevating coal, elevating coke for the producers, and for filling retorts after scurfing. Why should the gas consumed for these purposes be included among "maintenance" costs? The gas consumed is as much a charge to manufacture as the fuel used for carbonization, and therefore should not be ascribed to maintenance. The item for the repair and maintenance of extractor gear is 0·39d. per ton. Then again, we come to a charge of 0·812d. per ton of coal for gas used by small engines for coke extraction. This we should allocate as a manufacturing, and not a maintenance, charge. The maintenance and repair of the coke-elevator is 0·414d. per ton of coal carbonized (3·324d. per ton of coke elevated, which is expensive). The bench ironwork required an expenditure of 0·455d. per ton of coal carbonized. This is heavy; but it is explained by the fact that this is an experimental station, and a large part of it was due to discarding the original type of mouthpiece, and introducing an improved form. Other improving work, too, has been carried out. Then we come to the most important item of all. The total cost of the maintenance of retorts and producers works-out to 6·5d. per ton. The author no doubt had his expectation gratified that "the method "adopted for obtaining the costs [in this connection] would "not meet with the approval of some of the members." The total costs include the original costs of retorts, floor tiles, linings of settings and producers, £980; and the rebuilding of No. 2 and No. 1 settings, respectively £453 and £543. Deducting these three items from the total of £2689, the balance is £723. Of this, £148 represents the cost of the producer ironwork—a figure which is very high. Mr. Buckley admits surprise that the sum expended on furnace and spear bars was no less than £98. This item is one which, with the present step grates, is almost entirely eliminated. The retort-house governor is only accountable for 0·06d. per ton of coal carbonized; and inspection, greasing, stokers' mitts, and timber are jointly charged at 0·492d.

These constituent items show how the high maintenance figure of 10·613d. per ton of coal carbonized is arrived at. It is not a representative figure, through the original type of plant, abnormal conditions, and inclusions of charges which some people will think ought not to be there. Nevertheless, the maintenance data have interest as applying to an original installation of continuous verticals, and at war-time charges. Furthermore, the paper has interest to those who remember the one that the late Mr. J. G. Newbigging read at the meeting of the Institution of Gas Engineers in May, 1911, on "The Scientific Carbonization of Coal." That paper in those days reflected the enthusiasm of the author for the system; his enthusiasm would be intensified with the present-day methods of design and operation. As we look at the tables at the end of the present paper, and see that away back in the year ended March 31, 1912, the cost per therm into the holders from these original settings was only 2·203d., and in the year ended at March 31, 1916, 1·955d., we can see how well the early enthusiasm was justified. But the 165 p.ct. increase on the cost of the therm into the holder at March 31, 1921 (5·847d.), indicates to us, when compared with the production costs with modern settings at the prices ruling for coal and labour in 1921, how far we have since 1910 advanced in the scientific carbonization of coal in continuous vertical retorts.

Surface Combustion Developments.

Flameless incandescent surface combustion, there appears no room for doubt, has come to stay; and we think there are fair grounds for predicting that, in the practical needs of the times, it is going to take a very important part and place. Regarded from a practical standpoint, what the surface combustion of a mixture of gas and air does is to increase the efficiency of application in the form of radiant heat, and the radiant heat can be distributed or concentrated according to the designed purpose. The war largely stopped development from those promising initial stages in which we were growing strongly interested in the opening years of the last decade; but the experience gained and the subsequent experimental work have produced auxiliary developments which encourage the belief that the field of application has been expanded to limits to which it is impossible to give any reliable definition. The paper that Prof. W. A. Bone read at the Royal Society of Arts on Wednesday last will do much to enlighten our readers as to the importance of modern development in subserving the original important discoveries that he made, in collaboration with skilled experimenters, as to the effect of incandescent surfaces in accelerating the combustion of gas and air mixtures, and thus enabling such a large proportion of the heat of combustion to be given off in radiant form.

The paper may be divided into two parts. In the first place, one gets a résumé of the scientific work which preceded that of Prof. Bone and his colleagues, but which only carried investigation to the point of demonstrating the power of solid surfaces generally to induce the slow combustion of gas-air mixtures at temperatures below their ignition points. But the researches of Prof. Bone revealed the fact that incandescent surfaces—surfaces having temperatures above the point of ignition—possess far greater powers in accelerating combustion. In other words, the accelerating influence of a hot surface upon combustion rapidly increases with the temperature; and, not only so, the differences between the powers of various surfaces (which, at low temperatures, are often considerable) diminish with ascending temperatures, until at bright incandescence they disappear altogether. The research work and disclosures make a long tale even when told in the condensed form in which Prof. Bone presented it; and therefore the paper (as published *in extenso* to-day) will have to be read by those who desire to refresh their memories as to the scientific exploration which led to practical achievement. This took two forms: The combustion catalytically of the gas and air mixture on the incandescent surfaces of specially constructed diaphragms (for domestic or industrial heating purposes), which caused a large proportion of the potential energy of the gas to be immediately liberated in radiant form; and the combustion of gas-air mixtures in tubes packed with suitable broken refractory material, for the purpose of application to steam-raising.

Eleven or twelve years ago—just before the war—the first practical applications were made, in furnace-heating and steam-raising at the Skinningrove Iron-Works, and at a sugar refinery. The principle of surface combustion has from the first been well established; but experiment and experience under working conditions were necessary to ascertain and to develop the best methods of application. It is in this connection that recent developments have been made. The early practical experience proved that research had not failed the workers in the matter of high efficiency, and that any difficulty which was found only meant the development

of more suitable means of application. For example, in the diaphragms first developed for heating purposes there was the possibility of such an accumulation of heat in the incandescent surface layer as to cause the seat of intensive catalytic combustion originally set up therein gradually to creep backwards from layer to layer in the diaphragm until pre-ignition of the mixture ultimately occurred in the feeding chamber. But now, through the patient labour of Mr. F. J. Cox, in conjunction with Radiant Heat, Ltd., and Prof. Bone, there has been a development in the fabrication of what will henceforth be known as "radiophragms," in which the possible trouble with the original diaphragms has been averted. To-day Prof. Bone is able to speak enthusiastically as to prospects in the heating field. He says: "It bids "fair to put diaphragm heating into an unassailable posi- "tion, and greatly to extend its scope of usefulness." The radiophragms can be produced in quantity by the new method with complete certainty and precision, and of such form, admixture, and gradation of granules, that no back-firing ever occurs, however much the radiation from the incandescent surface may be impeded. It is indeed a radical advance, which, it is believed, will make all the difference between the present limited application of radiophragms, and their ultimate extensive use in industry. The practical applications, with the predicted economies, are the matters in which our readers will be directly interested; and from what Prof. Bone says, it would appear that the combined discoveries of surface combustion and the radiophragm will open up to the gas industry a large field of enterprise. One statement in the paper will particularly claim the attention of those working on the commercial side of our industry. It is that Radiant Heat, Ltd., have fitted up numerous large restaurants in London and elsewhere with radiophragms for grilling, toasting, and cooking purposes with such success that large repeat orders have been placed and are being executed. And further, for application to water-heating and steam-raising purposes, there has been success recently in producing cylindrical radiophragms. An account of the work done in this direction is given in the paper; but a little later, when the methods of application have been further investigated, we hope to hear more as to this particular development.

Many of us remember the work that was done in the application of the system of surface combustion to steam-raising, and the installation of boilers at the Skinningrove Iron-Works in 1911, which boilers continued in operation for some years, and were then removed because the site on which they were accommodated was required for another purpose. Those boilers demonstrated much. They assured us that, in day-by-day working an efficiency of over 90 p.ct. could be obtained—that is to say, that upwards of 90 p.ct. of the net heating value of the gas was transferred to the water, and sent out as steam; also that the high evaporative duty per square foot of heating surface enabled smaller boilers than heretofore to be adopted for a given steam-raising capacity. Moreover, surface-combustion boilers do away with all the heavy work associated with coal-fed furnaces, boiler seatings, and big chimney shafts. The practical importance of all this to a works is too apparent to need elaboration for the purpose of emphasis. The efficiency of upwards of 90 p.ct. to which we have referred is the net efficiency of the boiler and feed-water heater, after deducting the pressure required to drive the fan.

All this, it will be conceded by everybody, is a striking accomplishment; and, in view of it, one can quite understand that Prof. Bone would feel somewhat acutely any criticism which suggested that there was something wrong with the principle to which such performance is attributable. In his recent paper [*ante*, p. 351], Major W. Gregson stated that these early types of boilers were found to need modifications in respect of these points: (1) The use of an explosive mixture in the burners, which allowed back-firing to occur unless care was taken every time the burners were adjusted; (2) the use of granular refractory packing, which occasionally gave trouble by breaking down, owing to intense local temperatures developed by lack of free radiation from groups of particles; and (3) the use of densely packed tubes and restricted areas in the gas passages, which meant very high suctions. Towards the end of his paper, Prof. Bone described the statement as to back-firing as "misleading;" and he gave his reasons. The allegation as to trouble through the use of the granular refractory packing, he also asserted was untrue so far as his knowledge went; and he deliberately said he did not believe it. He asserts that no difficulty was met with in the boiler part of the installation, or in the gas-feeding or combustion arrangements. The only real or serious difficulty encountered arose out of the very efficient cooling of the products of combustion in the feed-water heater, and the consequent corrosive action of the small amount of sulphur oxides which they contained on the outlet tube plate and the fan mechanism beyond it. What really happened was that the average temperature of the products of combustion leaving the boiler, when evaporating at a gauge pressure of 95 lbs. per sq. in., was almost 385° Fahr. But in the feed-water heater the temperature of the products was reduced to 200° Fahr., which was too low to prevent corrosive action on metal surfaces. Hence the injury to the outlet plate and the fan mechanism beyond. It would have been a simple matter to omit the feed-water heater altogether, or to instal a less efficient one, so as to keep the temperature of the gases entering the fan above 350° Fahr. It is quite probable that had one of these precautions been taken nothing would have been heard of the difficulty, which is clearly a surmountable one. But we learn by experience; and by experience as well as by research improvement and progress are made. It is not, however, this point on which there is a difference between Prof. Bone and Major Gregson. What Prof. Bone objects to and calls "retrograde," is the radical departure from packed to unpacked tubes, to which the latter alluded, and which is the negation of advantage in surface combustion for this particular purpose. The fact remains that the Skinningrove boilers accomplished an efficiency that had never been realized before; and the faith in them of Prof. Bone is so strong that he would have no hesitation in installing boilers of the same design, with certain modifications in detail, for either coke-oven or town gas, being confident of their exceptionally high thermal efficiency, rapid heat transmission, and smooth working. The developments of the applications of surface combustion of gas-air mixtures promise considerable technical interest and new commercial activity.

At the "S.B.G.I." Meeting.

THERE were several matters of interest referred to at the meeting of the Society of British Gas Industries last week. They are found spread about in the annual report of the Council, the address of Lord Riddell (who has been succeeded in the Presidential Chair by Lord Weir of Eastwood), and in the speeches at the dinner. There is one feature of the all too brief address of Lord Riddell that was striking. Though much concerned in political affairs, he shows that he is well-endowed with the natural impulses and ideas of a sound commercial man; and in this regard he sees and views things in right perspective. Though his association with the gas industry, through the presidency of the Society, has not been a long one, he recognizes that the sale of gas is fundamental to an increase of the prosperity of the industry in every part, and that the way to enlarge the sale of gas is by thorough methods in imparting information to the public. He also concedes that much in this direction is being done by the "B.C.G.A.," and that it has greater scope than it can at present fill through the inadequacy of its means.

Behind what he says, one can detect the opinion of Lord Riddell that the methods in this respect of many gas undertakings have not hitherto been as perfect as is desirable, and as they must be. In this connection, he is an observer, not a performer; and he regards things from the point of view of the consumer. In his experience, he has found methods practised by gas undertakings of which he can justly complain, and which are diametrically opposed to the best interests of the industry. At one time his Lordship was himself ignorant of the latest improvements in gas lighting and heating, and was dissatisfied with his appliances. He is not so ignorant to-day. But his former ignorance is that of many men and women. He knows this now, through the improvement that he has secured in his gas-fittings by publicly denouncing, at the Bristol conference of the "B.C.G.A.," those that he had. He took a good opportunity; and we applaud his discernment. The highly efficient gas appliances that he now possesses are the admiration of a large circle of friends. His personal experience leads him to ask whether it is not possible to improve the education of the public; and while he obviously approves of the fresh steps that are being taken by the gas industry to effect this by beginning at the correct place—

the education of the industry's own people—he emphatically urges gas undertakings to explore the methods adopted in their dealings with the public, and, where necessary, revise them. As he truly says, when people have secured the information they desire, they do not want to be met with hindrances on the part of the gas suppliers in the district in which they reside. Such hindrances should be eradicated. The best way to do any business is to make things as easy as possible for the customer, and to see that he gets the best appliances that are available, if satisfaction is to be realized. This is sound advice. But he goes beyond it. He tells us how many people possess antiquated appliances, but fear to change them because of the expense. He is of opinion that this would be altered if the householder were shown that the new outlay would be saved by increased efficiency and future economies. That is right enough where sales of appliances are concerned; but so many of the gas appliances in domestic service are there on hire terms. In the aggregate, therefore, they represent a large amount of capital, and so cannot be sacrificed until the day comes for replacement. But much could be done to improve them, though one cannot expect to raise their efficiency to quite the same level as that of modern designs. Lord Riddell also advocates periodical inspection and advising of both domestic and industrial consumers by competent men. In this direction, there is for the industry now greater inducement than hitherto; and the requirements of the Gas Regulation Act are assisting in this.

The new President of the Society (Lord Weir) needs no introduction to engineers. He holds a place of eminence in the profession; and he gained inestimable laurels for his work in connection with aerial offence and defence during the war. In his speech at the dinner of the Society he said many philosophic things upon which one could ponder long, and expand. He emphasized the importance of a continued development of technical efficiency in order to regain stability and revitalize enterprise and industry. In his opinion, at no time in the history of the gas industry has technical efficiency had behind it more compelling forces than it has to-day. There is one factor that has special import in these times; and he finds in the gas industry an excellent illustration of the point he made. The point is one to which we have frequently called attention. It is that of the interdependence of industries; and if this condition were taken more into account by those who direct each industry, the way, we feel sure, would be paved to a larger measure of industrial prosperity. But a very general view is that each industry must look after itself, as though it were complete within itself, and had not to rely for purchase or sale upon other industries. This is merely the enlargement of an all too prevalent individual selfishness. The gas industry, as Lord Weir points out, is interlocked with other industries through the number and variety of its requirements and products—in short, it permeates the whole structure of our civilization, in transport, power, agriculture, and manufacture. In this way it exemplifies, and is, he feels, the pioneer of, the coming era of interdependent industries. No great industry to-day forms a complete and self-contained activity; and therefore his Lordship believes that we have hardly yet become aware of the full possibilities of the economy which is latent in a better correlation of industries. He criticized, too, those amorphous ideals of socialistic brains which would be destructive and not constructive. There cannot be full energy and enterprise under the shadow of changes in our social system—under changes based on some new notion of community or social service. There is no half-way house in which to rest between socialism and private enterprise. There must be freedom to develop along the best evolutionary lines; revolutionary lines are no good. If these sound ideas are generally accepted, then there is a bright future for industry generally, and in that future the gas industry will occupy no mean a place.

Revolutionary notions such as Lord Weir referred to require to be met by something of a practical nature, which would be understood by the people. In a subsequent speech by Mr. D. Milne Watson, he expressed the belief, based on a large experience, that the antidote to all the wild talk of the Communists and Socialists is to give the employees of industry a greater part in it. We are with him in the view that it is little use talking to people who have no capital (or little hope of obtaining any) of the inestimable blessing that capital is, and the inestimable work that capital does. The best way to persuade a man that capital is good is to give him an interest in capital; and therefore the Governor of the Gas Light and Coke Company advocates the spread of co-partnership in every direction. By way only of illustration, he instanced his Company. They have 15,000 workmen; and assuming that these men represent, on an average, a wife and three children, this means five times 15,000 who are interested in the Company and in its capital. The Company serve a population of some three millions; and therefore the 75,000 (workers and dependants) interested in the Company's capital represent one in forty of the entire population in the Company's area. Of course, this does not include the ordinary or preference stock holders or the debenture holders. The illustration is interesting. It points the way to beneficial work. If all companies in a considerable way of business adopted co-partnership on lines which enabled investment in the concern, the ratio of one in forty employees interested in capital would quickly change for the better; and then—gradually perhaps—we should hear less of differences between capital and labour, and communistic ideals would surely recede farther and farther into the background until lost sight of, and that for ever.

Central and Local (Direct) Taxation.

Into this matter an inquiry has been instituted by the Federation of British Industries; the subject being of vital importance to every industry. Through the National Gas Council, a questionnaire has reached the responsible heads of gas undertakings; and it is desired that this should be treated as a matter of urgency.

Standard Gas-Valve Flanges.

We have recently had inquiries regarding this matter. There is news of it in the annual report of the Council of the Society of British Gas Industries. The Sub-Committee who have been dealing with the question have adopted a new standard for gas-valve flanges; and it is believed that this will be acceptable to gas undertakings. The Council of the Society have approved; and there is agreement on the part of the Council of the Institution of Gas Engineers. All should therefore now be well in this respect. The proposals have been submitted to the British Engineering Standards Association for adoption.

Standard Inverted Gas-Burner.

From the same source of information, it is learned that a Committee appointed by the British Commercial Gas Association and one representing the Society have been considering the question of the standardization of inverted gas-burners. The Committee of the Society have prepared a specification which has been approved and accepted by the "B.C.G.A." Prior to issuing licences for the manufacture of the standard burner, the Society are waiting for the acceptance by the Patent Office of a registered mark to be used for stamping registered burners.

The "Case" for the Coal Fire.

So much has been said lately about the smoke-polluting and labour-creating abilities of the coal fire, that we were not aware that coal for domestic heating had anything much left that it could put forward as a "case." The Coal Merchants' Federation of Great Britain think that it has; and so they have printed and published a circular, headed "The Case for the Coal Fire." Coal merchants are sending these out with their accounts and receipts. It is a poor case; but apparently it is the best that can be done. The coal merchants are apparently feeling a draught somewhere. In the first paragraph of the circular, it is said that the amount of heat generated by coal to the value of 8d. would cost by gas 2s. 3d., and by electricity 8s. These figures, it is said, have been obtained by scientific tests and thorough investigation. We are afraid we must assert that, so far as the comparison is concerned with gas, the scientific tests went somewhat astray, and that the investigation was not so thorough as it might have been. Let us see. With coal at 50s. per ton and of a calorific value of 13,000 B.Th.U. per lb., 8d. would buy 384,800 B.Th.U. Scientific tests assure us that the best efficiency one can get from a coal grate is 20 to 24 p.ct.; and 24 p.ct of 384,800 B.Th.U. is 92,350 B.Th.U. With gas at 9d. per therm, 300,000 B.Th.U. can be bought for 2s. 3d. Scientific tests tell us that the efficiency of the modern gas-fire is approximately 75 p.ct.; and 75 p.ct. of 300,000 B.Th.U. is 225,000 B.Th.U.—more than double as much useful heat as is

obtained from the coal fire. Now if we take 8d. worth of gas at 9d. per therm, about 89,000 B.Th.U. would be purchased. This potential energy, used at 75 p.ct. efficiency, would give us 66,750 B.Th.U. given off as useful heat. This is not a great way behind the fire using eight pennyworth of coal. With a gas-fire it is rarely that eight pennyworth of gas is used at once. The fire is lighted and extinguished as needed, and so great savings are effected. The coal fire when once lighted has to be continued, unless the labour and worry of rekindling are incurred. Coal and heat is wasted through this disability promptly to render service only as and when required; while gas promotes great saving through the ability to serve only as and when needed. There is no labour involved—no fetching and carrying of coal; no "making" fires, no dust or dirt, and no pollution of the atmosphere by smoke. The coal merchants say nothing of these points which stand to the discredit of this crude burning of coal. Their figures sadly stand in need of revision.

Other Statements.

The other statements in the circular are equally as insensate and just as easily refuted. For example, it is said that "food cooked by means of heated fumes given off by gas cannot be fit for human consumption." The coal merchants do not state the chemical nature of those so-called fumes. But it is a singular thing that food cooked in gas-ovens should not be fit for human consumption, when practically the greater part of the nation is fed on such food, and has been for many years now. Then the householder is told that he can select the quality of coal that exactly suits his requirements. He cannot, because he knows nothing whatever about the quality. Even large buyers have to analyze coal to see that they are getting what they require. The householder is further informed that he cannot select his quality of gas. If he cannot do that, he can adjust his burners to the quality which is supplied to him; and the quality is in these times under the Gas Regulation Act fairly uniform from day to day. Then the housholder is told of the "monotonous hissing, irritating effect of a gas-fire." There is no indication in the circular as to why gas-fires continue to be fixed in such large numbers.

Increase in Miners' Wages.

Certain statements were made the other day in the House of Commons, on the occasion of the introduction of a Bill to amend the Coal Mines (Minimum Wage) Act, 1912, regarding miners' wages, which altogether obscure the current tendency of these in an upward direction. The Mining Association have naturally taken note of this; and they have put the matter right by issuing a statement on the subject. They say that, assuming that 6s. 5d. is the correct average pre-war wage, it is certainly not the fact that 9s. 6d. represents the present average earnings, although this figure has been officially given as the average for the last quarter of 1922. Wages have since risen, and show a pronounced tendency to rise still higher. They stood at 9s. 8·7d., or an increase of 49·2 p. ct., in January and February; while it is estimated that current earnings, which are based upon the working results of January-February, average over 9s. 10d. per shift, which is equivalent to an increase of 53 p.ct. above the pre-war level. It is expected that the next ascertainment will show a considerable increase over the latter figure. For some reason this upward movement is overlooked, and no allowance is made for free or cheap housing and coals, which privileges are enjoyed by the bulk of the miners, and which constitute an important item in the cost of living.

OBITUARY.

The death has taken place of Mr. J. Belton, for many years Manager of Carrick-on-Shannon Gas-Works.

The death occurred on the 27th ult. of Mr. Arthur Oliver Silverthorn, Consulting Engineer, of No. 5, Victoria Street, S.W. The deceased gentleman, who was 76 years of age, was well known to gas and water engineers, more especially in connection with rating matters.

The offices of the Institution of Chemical Engineers have been removed from No. 166, Piccadilly, to Abbey House (Rooms 306 and 307), Victoria Street, Westminster, and the address of the Chemical Engineering Group from No. 24, Buckingham Street, Adelphi, to Abbey House (Room 308), Victoria Street, Westminster.

PERSONAL.

Last Wednesday, Mr. Wm. F. Whittaker, the Secretary of the Grays and Tilbury Gas Company, was the happy recipient of a handsome chiming clock, presented to him by the staff and employees as a mark of the esteem in which he is held, upon his completion of 21 years' service among them. The presentation was made at the Company's offices, in Orsett Road, by Mr. A. W. Sumner (the Engineer and Manager), in the presence of all the staff and a large number of employees. Mr. Sumner pointed out that Mr. Whittaker had steadily risen from a junior to his present position of Secretary, which post he had held for eleven years. Mr. Mumford, on behalf of the office staff, in supporting Mr. Sumner, bore testimony to the pleasure it gave them all to serve under Mr. Whittaker. He was not only an excellent chief, but also a good friend to them all; and having climbed from one position to another, he had practical sympathy with every employee under him in all branches of the work. Mr. Whittaker, in responding, thanked them all for their generous gift and goodwill. He was delighted to know that his work among them was so appreciated; and he confessed that he could not find words to express how highly he prized their esteem. His period of service with the Company had been one of great pleasure; and he was proud of the fact that he had always received the loyal support of the employees of all the different departments during the whole of that period. He sincerely hoped that he would continue to merit their esteem for many years to come.

The April issue of "The Croydon Co-Partner" contains a portrait of Mr. William Cash, the new Chairman of the Croydon Gas Company; Mr. Charles Hussey having for reasons of health been compelled to relinquish the position, which he had held for 31 years. In an address to the officers and workpeople of the Company Mr. Cash points out that he has lived in Croydon all his life, and has had a seat on the Board for nearly 25 years, so that he does not take up this new position without knowledge of the work involved. He adds that the Croydon Gas Company has always stood for a prosperous and well-managed undertaking, providing a public service with efficiency for the citizens. They were fortunate now, and in the past, in having able and capable officers, supported by a loyal staff and workpeople zealous in their duties and keen for the reputation of the Company. In his opinion, it is this fact that has brought success.

Fifty-four years in the gas industry, and still "not out," is the notable record of Mr. John Alfred Harris, the Secretary and Manager of the Great Wigston Gas Company, Leicestershire, who, on May 11, completed forty years' service with that Company; and his many friends, both in the profession and out of it, will extend to him heartiest congratulations on this attainment. Mr. Harris, who will soon be 70 years of age, is a native of Droitwich, where his early training in the gas industry was obtained. After leaving school, Mr. Harris served a seven years' apprenticeship at the Droitwich Gas-Works, and immediately following that was for seven years Engineer at Gillingham, Dorset. Then he went to Leicestershire—his total service to date being 54 years. The esteemed Manager of the Wigston Gas-Works comes of what might be termed a "gas manager" family. His father was a Gas Manager, and his younger brother, the late Mr. A. T. Harris, was for twenty years Gas Engineer at Market Harborough. In addition to this, Mr. Harris has the rare distinction of having four sons gas managers in various parts of the country. They are Mr. W. H. Harris, at Brigg, Lincolnshire; Mr. John E. Harris, at Thrapstone, Northants; Mr. A. T. Harris, at Maryport; and Mr. Clarence Harris, at Taunton. Mr. Harris has been a member of the Institution of Gas Engineers and the Gas Institute for over thirty years. When interviewed by our Leicester correspondent, Mr. Harris recalled that when he was appointed on May 11, 1883, as Manager (he was later appointed Secretary as well), the production of the works at Wigston was 3 million c.ft.; whereas to-day it is 58 million c.ft. During his period of management entirely new works have been erected.

Mr. E. Nock, son of the late Gas Manager, who has temporarily filled the post since the death of his father, has now been appointed permanently to the vacant position at the Newtown Gas-Works.

Mr. B. W. Smith, who has just retired from the position of Gas Engineer and Manager at Walsall, was last week the recipient of a gift in the form of a cheque from the chief officials of the Corporation. The Town Clerk (Mr. H Lee), who presided, stated that Mr. Smith carried with him the best wishes of his colleagues for long life and good health in his well-earned retirement. The Borough Surveyor (Mr. J. Taylor), who made the presentation, referred to Mr. Smith's long and successful service under the Corporation. Since he was appointed 23 years ago he had almost entirely reconstructed the works, and had helped the rates to the extent of many thousands of pounds. Mr. Smith suitably responded.

Mr. Walter Hole has been appointed Organizing Secretary under the new scheme for the education and certification of young men engaged in the gas industry.

The highest honour awarded by the Institution of Electrical Engineers, the Faraday Medal, has been presented to the Hon. Sir Charles Parsons, K.C.B., F.R.S., inventor of the modern turbine. The medal is for conspicuous service in the field of electrical engineering. Sir Charles Parsons is a member of the Fuel Research Board.

ELECTRICITY SUPPLY MEMORANDA

A paper was recently read before a small number of the members of the Institution of Electrical Engineers by Messrs. L. Breach and H. Midgley on "Power Station Auxiliaries." The authors have been making an exploration into the supply of power for the auxiliaries of a modern power station; but the outstanding feature of the paper was the discussion of the question of reliability, which should be the primary consideration of the engineer, and to achieve which no expense should be spared. Auxiliaries were divided by the authors into four groups: (*a*) Those which must not on any account stop. This includes the main circulating water supply, the air extraction, and the station lighting. (*b*) Those which must not stop for more than (say) sixty seconds. This includes the boiler-feed pump, and the power for the control circuits. (*c*) Those which may stop for up to about five minutes, but not longer. This includes water extraction, individual stokers, individual forced-draught and induced-draught fans, and ventilating fans. (*d*) Those which may stop for a period of up to about twelve hours without shutting-down the station. This includes coal and ash conveyors, coal-crushers, pumps for water-softening plants, and economizer-scraper motors. "Auxiliaries," of course, do not embrace the main generating plant; but the mere citing of these various groups shows the extraordinary number of seats of potential failure that there are in connection with electricity supply. The times quoted, too, during which it is permissible—according to the authors—for any one of these to stop are also instructive. As we have known of electricity stations being shut-down for longer periods than even the highest permissible one for group (*d*), it shows there are other sources of accident in electricity generation and supply than those that can be laid to the charge of the named auxiliaries. The risks of stoppage appear to be almost infinite; and when cessation of supply does occur, it is very effective, through the absence of storage. There is nothing so critical about gas production and supply; nothing (given fuel supply) but the flooding of all the furnaces in a works, or the complete destruction of all the manufacturing plant, would cause a complete stoppage of gas distribution, after the storage had given out. The manufacturing plant being divided into small units—relatively "small" to the total production—is another protection.

The "Auxiliary" Seats of Stoppage.

We cannot follow the authors through their extensive paper; but there were two or three remarks in the discussion which are of particular interest. Mr. W. B. Woodhouse, of the Yorkshire Electric Power Company, expressed his appreciation of the authors having placed reliability in the forefront of their programme. In his opinion, undue emphasis is often placed on production costs, and especially fuel costs, at the expense of other factors. Mr. H. Brazil calculated the financial loss of a two-hours' breakdown on a London supply station at no less than £1000 in revenue to the undertaking, to say nothing of the loss to consumers whose motors were put out of action, and the works' plant rendered idle. There is no need for the exercise of much imagination to come to the conclusion that, in an area with a heavy industrial power load, the loss of a two-hours' stoppage to the manufacturers would be immensely greater than that to the power station. We have known—electrical engineers have known—of stoppages, and repeated stoppages, in supply areas, that have caused several factories to stand still, and have put out of employment sometimes, not only for hours but days, thousands of workmen, and so have done harm to a heavy monetary extent both to output and wages. The private generating plant is considerably more reliable than the public supply plant, because it is under more perfect control; and being of smaller character, the likelihood of failure is not so great. Moreover, in the event of a breakdown, it only affects the individual works, and not a number as in the case of a breakdown at the central station. The convenience of the electric drive, with the energy derived from a central station, may soon have its advantage wiped-out by an unexpected failure stopping the factory output.

The Cost of Failure.

For a long time past, in the electricity supply industry, there has been discontent on the part of the contractors and the retailers as to the amount of material encouragement they get in trying to dispose of electrical appliances to the public. The channels through which the appliances come act as a sort of sponge for profits before the contractors and the retailers have the handling of them; and when this condition is added to the cost of production, the retail price of the appliances becomes rather unattractive to the public. The Electrical Contractors' Association have had a Special Committee considering the fundamental principles that should apply to electrical trading policy. They find that the industry is not so well organized as it should be, especially with regard to the methods of distribution to the user; and therefore they urge that some improved relationship between the manufacturing, wholesaling, and retailing sections of the industry must be set-up before the best results can be achieved. They have, therefore, been trying to find a basis on which such improved relationship may be built. But all they say and recommend is purely suggestive; and the recommendations are intended to direct and guide without being in any way binding. We admit that in part the proposals are quite good; but, of course, the presentation of the finest ideals on the part of one organization in the industry cannot be in any way obligatory upon the other parts, however proper they may be. The electrical industry badly wants to ensure good work; and it also desires a fair profit for all. But it comes to this—that if what the Special Committee of the Contractors' Association propose simply means the shifting of part of the profit from one section of the industry to another, this will not in itself contribute to the cheapening of the goods to the public. A larger share of profits to the contractor and retailer would naturally conduce to greater enterprise on their part in attempting to effect sales with the public. But whether this would increase in any material way the turnover of the industry, and so do good to everybody by enlarging sales, is open to considerable doubt.

Trading Policy.

While the Committee do not suggest that the recommendations can be carried into effect immediately, or, as regards some of them, for a long time perhaps, they consider that the policy now formulated should be followed consistently, and, so far as is possible, in making trading agreements. The broad principle of the Association in trading is, by co-operation or otherwise, to establish its membership in a sound position commercially and financially, so that it can control the details of its own business without undue interference from any other section of the trade. This intention is put at the head of the recommendations, and from it there has been evolved all that follows. In the first place, the Association aim at obtaining such a share in the control of the electrical retail trade as will ensure that all regulation of the conditions of retail electrical trading is carried out with their collaboration and consent. That is rather far-reaching; and we can see the retailers (as distinct from contractors) and the wholesalers objecting strongly to any regulation of the conditions of the retail trade by the contractors. But the Committee assert that their aim is to improve the conditions of the retail trade generally. But this may be questioned in interested quarters—it is not likely that other people will be able to see a genuine disinterestedness in all this, particularly when to the recommendations are added the words: "To effect this end, the Association must aim at strengthening its own membership and position by obtaining special benefits for its members." Then come the words: "It shall be an object of the Association to reduce the costs to the users with a view to increasing the turnover of the industry." That is a very pious intention. There are various ways in which it is proposed that this should be done. The intervention of the middleman between the manufacturer and the contractor or retailer must be eliminated, except in the case of such wholesalers as do genuinely reduce distributing costs by carrying a substantial stock and supporting the manufacturer by large contract buying. Contractors and retailers are also to reduce costs by buying in quantity. The members of the Association, it is suggested, should undertake the running of retail showrooms, and generally introduce to the user new inventions and designs. Manufacturers and wholesalers should be discouraged from direct trading with the users. And there is much else. Among the other points, it is noticed that the Association should support any moderate scheme of "price maintenance" put forward by the manufacturers. An attempt, too, should be made to secure the general principle of discount upon quantity, in addition to a trade discount reserved exclusively for resellers, so as to eliminate the wasteful expense attached to small-parcel buying. We are left wondering whether all this will mean any real advantage to the public. There will be doubts in many minds.

The Lines of the Recommendations

While the contractors and the retailers want a larger picking from the profits on electrical appliances, it seems that the makers have not had a particularly rosy time lately. The British Electrical Transformer Company, who are the manufacturers of "Tricity" appliances, report that their gross profit on trading last year was £78,000 less than for the previous year, due to the slackness of trade generally, and the low prices ruling for the Company's products. The available balance (with the amount brought forward) allows of the payment of the 7 p.ct. dividend on the preference shares, the placing of £4000 to depreciation reserve, and the carrying forward of £8137. The Chairman of the Company (Mr. A. F. Berry) fears that it will take all the present year to get on to *terra firma;* and he believes the Company will certainly be well into next year before such a profit-earning stage will be reached as to permit of any appreciable distribution to the holders of ordinary shares. Then there was this depressing admission: "Although the actual volume of business is now growing, and the orders to date amount to more than the first four months of last year, the position is that the Company are now virtually very near to giving two halfpence for a penny." There was an appeal to the shareholders for greater support in ordering "Tricity" appliances, or hiring them in view of the fact that they can now be so secured in many towns. Mr. Berry is a prophet as well as a manufacturer. He declares that we are at the dawn of greater electrical developments than many people imagine. Perhaps the "many" see matters in a light very different from that in which Mr. Berry inspects them; and it may be they take into consideration factors which that gentleman

Bad Trade.

ignores. However, he very strongly urged the shareholders to make inquiries as to the hiring of "Tricity" appliances. Apparently, seeing that they require so much urging, the shareholders have not hitherto had much faith in them.

The Truth, and Nothing but the Truth.

Many people who have the best interests of the community at heart wish for a cleaner atmosphere by the prevention of smoke pollution. Quite a number of electrical men are desirous that a more sanitary atmosphere shall be obtained; but they want to secure it the electrical way. Well this simply cannot be done, because a method of heating the cost of which is so far removed from that of heating by coal, is not likely to achieve the object. It is more probable than not that it would simply defer the progressive freeing of the atmosphere from the dirty outpourings of chimneys. Last week reference was made to a letter that Mr. W. B. Baxter, a member of the Leith Electric Committee, had addressed to the "Electrical Review" on the subject of an editorial which had appeared in that paper on "Helping Smoke Prevention." The Editor, as we indicated last week, made a very inconclusive reply to Mr. Baxter. This gentleman in a further letter again puts our contemporary into a tight corner; and it replies with more generalities. There is one pregnant paragraph in the letter which is worth quoting, though the whole of it is quite good. He asks the "Review":

> Are you justified in saying that thermal units and, I will add, efficiency are fallacious comparisons? And if so, what other standard would you suggest? Can you dispute that out of every 100 heat units produced by combustion in the central station boiler furnace, 92 are lost and only 7·6 are available to the consumer? How is it possible to make this pay any other way than by charging the lighting consumer between twice and three times more than the power consumer? You say the electric-fire is more efficient than a gas-fire. It is true that if an electric-fire be placed in a room and no circulation of air allowed, then somewhere about 90 p.ct. efficiency may be claimed. But people could not live in such an atmosphere; and if the air is changed, the discharge air would carry away the heat—thus reducing the electric efficiency to not far from that of the gas-fire. Gas can allow a 90 p.ct. efficiency to the electric-fire, and still be about three to four times cheaper.

In his concluding remarks, Mr. Baxter advocates the combination of gas production and electricity generation, in order that the bye-products of coal carbonization may be preserved, and not wasted as under the coal-fed steam-boiler. If the "Review" cannot, or will not, deal with these matters on the basis of comparable data, then it had better leave the matter severely alone.

Limits of Electrical Heating.

We extract this paragraph from the South Metropolitan Gas Company's "Co-Partnership Journal": "A New York journal, devoted to the interests of electricity, has been warning its readers against the vain hope that electric heating is destined to bring about the 'chimneyless town' of which enthusiasts have dreamed. The article states that electrical energy is too expensive for domestic heating, and goes on to remark:

> Here and there locations may be found, such as the Gila or Mojave deserts or the southernmost part of Florida, where the amount of heat required is so small that it is economical to make it all electrically. In almost every other section of the country, electric heat is out of the question, except as an auxiliary to some other form. Patrons who seek this luxury should be apprised of its great cost, and discouraged in its use as a matter of public policy.

This testimony is valuable; and the advice is good—on both sides of the Atlantic." No further comment is needed.

THE FRENCH GAS ASSOCIATION.

The programme is now available of the Annual Congress of the French Gas Association, which is to be held at Chambéry on June 18, 19, and 20. The local hotels cannot accommodate more than about 50 visitors; but Aix-les-Bains is only some 10 miles distant, with excellent communications, including special trains morning and evening. Besides the usual business of the meeting, there will be a dinner on the evening of the 18th at the invitation of the Gas and Electric Companies of Aix, and a subscription dinner, also at Aix, on the 19th. Excursions have been fixed for the 20th. At the invitation of the Italian Gas Association, it has been decided to attend their Congress at Milan on June 22, travelling *viâ* Turin, and returning to Paris on the Sunday. Complete arrangements have been made for this interesting trip, including excursions to Turin and the lakes, first-class railway fares, hotel accommodation, &c., at what appears the very moderate cost of 450 frs.

Bye-Product Coking.

From Messrs. Benn Brothers, Ltd., 8, Bouverie Street, London, E.C.4, we have received the second edition of the book written by the late Mr. G. S. Cooper entitled "Bye-Product Coking," which was first published in 1917. The new edition has been enlarged and completely revised by Mr. E. M. Myers, F.C.S., and a review of the work will shortly be published.

NATIONAL GAS COUNCIL.

Meeting of the Central Executive Board.

The Central Executive Board of the National Gas Council met at No. 30, Grosvenor Gardens, S.W., on the 8th inst.—Mr. D. MILNE WATSON in the chair.

GAS REGULATION ACT—GAS (AMENDING) ORDERS RULES, 1923.

The publication of these Rules (dated April 16) by the Board of Trade was reported.

PRECAUTIONARY MEASURES IN THE DISTRIBUTION OF GAS.

It was reported that the Committee of the Council who are dealing with this matter had met to consider the recommendations of the Joint Conference at the Board of Trade with regard to additional precautionary measures in the distribution of gas.

DIVERSION OF MAINS.

A meeting of representatives of the Council with the Water Companies' Association on April 25 was reported, when it was agreed that a joint deputation should interview Sir Henry Maybury at the Ministry of Transport with regard to an amendment of the law relating to highways, so that compensation could be obtained from bodies such as county councils, &c., for the diversion of mains, as in the case of urban district councils. Two representatives were nominated by the Central Executive Board to represent the Council at this deputation; the water companies having likewise nominated two representatives.

DRAFT SCHEME OF ELECTRICITY COMMISSIONERS IN CONNECTION WITH LONDON ELECTRICITY SUPPLY.

In connection with the inquiry before the Electricity Commissioners which began on March 12, and was unexpectedly adjourned owing to the Electricity Supply Companies having questioned the validity of the scheme, it was reported that the Companies had made application to the High Court, but had been unsuccessful. It was therefore presumed that the inquiry would now be resumed.

FINANCIAL CO-ORDINATION IN CONNECTION WITH THE VARIOUS DEPARTMENTS OF LOCAL AUTHORITIES.

A further case was considered where the Borough Accountant of a local authority was taking steps to have the gas accounts and other matters transferred to his own control. It was reported that a meeting of the Conjoint Watch Committee formed by water, gas, tramways, and electrical interests was being held on the 9th inst., at which representatives appointed by the Central Executive Board had been invited to be present.

BRITISH STANDARD SPECIFICATION FOR CAST-IRON PIPES.

It was reported that a Memorandum had been forwarded to the British Engineering Standards Association, setting out the suggestions which had been made by the Committee appointed by the Central Executive Board for the revision of the above Specification. The Memorandum, it was stated, would appear in the next issue of the Council's Monthly Report.

ANNUAL REPORT AND ACCOUNTS.

The annual report and accounts for the year ended March 31, 1923, were submitted and adopted.

BRITISH EMPIRE EXHIBITION, 1924.

A joint meeting was reported to have taken place between the British Commercial Gas Association and the various bodies interested in the gas industry, when it was decided that the gas industry should be represented at this Exhibition. A Committee representing all the bodies interested in the gas industry has been appointed to raise funds, and to make the necessary arrangements for the exhibit.

BUILDING MATERIALS INVESTIGATION COMMITTEE.

A resolution was reported to have been received from the Manchester District Institution of Gas Engineers, calling attention to the present unjustifiable prices of refractory materials for retort building, and asking that the Special Committee sitting on the Building Materials Investigation Committee should include these materials within the scope of their inquiry. At the time of the receipt of this resolution, the Government Committee referred to had not been set up. On April 19, however, the constitution of the Committee was announced in the House of Commons. A small Committee was appointed by the Central Executive Board to take the necessary action in this matter, after the exact terms of reference to the Government Committee referred to have been ascertained.

MR. J. H. ELLIS, PLYMOUTH.

The Central Executive Board expressed their great pleasure at the news that Miss Ellis, the granddaughter of Mr. J. H. Ellis, the Vice-Chairman of the Central Executive Board, had been safely restored to her father.

The series of articles in "World's Work" this month is continued by a contribution from the pen of Mr. H. James Yates, Chairman of Radiation, Ltd. It is entitled "Solving the Smoke Problem with Gas."

GASEOUS COMBUSTION AT HIGH PRESSURE

[PART III.].

Lecture by Prof. W. A. Bone, D.Sc., Ph.D., F.R.S., M.R.I., at the Royal Institution, May 11.

A more fitting place than the Royal Institution cannot be found in which to give to the world the first news of a new discovery in science. It is a storehouse of memories of those who laboured for the love of science; it embodies the spirit of English scientific thought and effort in the highest sense. Sir Humphrey Davy, Michael Faraday, and Sir James Dewar (to mention only three of these) have created standards by which men may measure their attainments.

In the lecture room a large and distinguished company had gathered to hear Prof. Bone. Promptly at nine o'clock the folding doors were closed behind the lecturer as he stepped up to the historic table from which Sir Humphrey Davy first demonstrated some of the properties of flame—a subject which has interested and baffled mankind (so we were informed) from the beginning of time, and yet remains to be elucidated in its entirety.

Prof. Bone outlined in a brief and masterly way (for his time was strictly limited to one hour) sufficient of his earlier work and conclusions on high-pressure combustion to make clear what was to follow. A touching and heartfelt tribute was paid to one of his brilliant young pupils, William A. Haward, who lost his life most tragically while assisting Prof. Bone in the earlier stages of this new work, at a moment when success was in sight.

When pure carbon monoxide is exploded under high pressures in a closed vessel with the theoretical amount of air necessary for its complete combustion, it burns relatively more slowly than does hydrogen under the same conditions. We learnt for the first time why this is; for in this fundamental research it is shown that nitrogen is not a mere diluting agent, as was always thought, but plays a most active part in the combustion.

When carbon monoxide is exploded under the conditions mentioned, and especially with an excess of nitrogen, it attains its maximum pressure more slowly, and the highest temperature reached is less than when hydrogen is used instead of carbon monoxide, though the amount of energy liberated is about the same in each case. It is as though the nitrogen were acting as a spring (to use Prof. Bone's analogy) in momentarily storing up the energy of the explosion, as would a spring under compression, and giving it out again on uncoiling.

If nitrogen, therefore, is the cause of this comparatively slow burning of carbon monoxide, and it is not due to an inherent property of the latter, a replacement of the nitrogen of the air by gases such as oxygen, carbon monoxide, or argon (which is known to have practically no chemical properties) should indicate what part nitrogen really plays in the explosive combustion. The result of this replacement of nitrogen was most interesting; for on exploding the carbon monoxide in the way indicated, the lecturer was able to show by an admirable series of photographic films (taken in a way that will be described in the "Journal" shortly) that the rate of explosion was little different from that of hydrogen in air.

Clearly, then, we have a carbon-monoxide-air mixture explosion, when at high pressures, profoundly modified by the nitrogen present in it, while a hydrogen-air mixture is not apparently affected in this way. The explanation of this is very ingenious, and is as follows. The influence of nitrogen in the carbon-monoxide-air explosion in a closed vessel at high pressures is to absorb a particular radiation given out by the chemical combination of the carbon monoxide and oxygen. There seems a similarity (so it is assumed) in the structure of the carbon monoxide and nitrogen molecules, so that when one reacts with oxygen the vibrational energy (called radiation) "broadcasted" thereby can be readily absorbed by the other, the two acting in resonance.

This view throws light on the cause of the different behaviour of hydrogen when compared with carbon monoxide under the conditions stated above, because it is known that the radiations from the flame of hydrogen burning in the air have a different wave length from those of the carbon monoxide flame.

At this point in the lecture Prof. Bone demonstrated two significant tests, by means of which he showed that in the water washings of the bomb in which carbon monoxide and air had been exploded, nitric acid was present, and was indicated by a deep blue colour; whereas in the washings made after an explosion with hydrogen and air, the absence of a blue colour showed there was none. At the high pressures developed in these explosions, it was possible in the case of carbon monoxide to produce nitric acid by the chemical combination of the nitrogen with oxygen. If the pressures were high enough, Prof. Bone predicted that it would be possible under his conditions of experiment to cause nitrogen itself to burn. This is of great significance because, as large quantities of blast-furnace gas are a convenient and cheap source from which to generate nitric acid by this method, it behoves us to consider the practical importance of this fixation of nitrogen from the air, and its consequent bearing on food production. Indeed, Prof. Bone uttered a warning not to allow the foreigner to grasp the fruits of British discovery before we had awakened to a full realization of their importance.

Interesting experiments were shown to illustrate the influence of hydrogen on the carbon monoxide flame.

THE POUNDS, SHILLINGS, AND PENCE OF INCOMPLETE COMBUSTION.

By Alex C. Ionides, jun.

By the courtesy of the Editor of the "Gas Journal" I address myself to the users of fuel.

We have read a speech by Mr. Lloyd George, an article by Lord Haldane in the "Manchester Guardian," and a series of letters to "The Times" and "The Observer" on "Smokeless Cities." In all these, the cure for the many and sundry evils referred to is ignored; and yet it can be wholly expressed in two words—complete combustion. But I am in entire accord with Mr. C. B. Tully, when he writes in the "Pall Mall Gazette" for May 9: "We are not making use of the greatest source of energy in the world—coal. We ought to gasify everything that cannot be coked, or is not worth coking, on account of the ash content of the coal."

So far, in Great Britain 90 p.ct. of our coal is still consumed ungasified. Only some twenty odd million tons of coal are annually passed through the retorts of gas undertakings. The annual cost of the gas they produce is to the consumer not less than forty millions sterling. Since the minimum waste of this through lack of complete combustion is 30 p.ct., it must be quite clear that there are at least 13⅓ million pounds sterling, or any part thereof, on this gas fuel alone to be saved a year by introducing a system of firing that ensures complete combustion.

This is easily talked about, but is only achieved under working conditions with special appliances. In 1915, a doubtless well-meant criticism was passed on my set of inventions by one of high standing in the gas industry. These were his words: "So far I am afraid you have not accomplished more than has already been done, by means of other methods, for securing complete combustion of the gas used." As already stated, this was in 1915. We are now in 1923; and I am still asking what are those other methods of securing and maintaining a neutral flame, and can discover none, except possibly the dangerous one of introducing a mixture of gas and air into pipes. (This last, in the nature of things, can only find a limited field of application.) If your readers know of any, I should be glad to hear of them.

Even with appliances which keep the mixture of gas and air constant, economy in gas firing will not be effected unless metering for each given heating device is insisted upon. The following incident will illustrate the position as regards this. "I do not see the economy your system affords," said one of the directors of a well-known company. "No," was the response; "gas is invisible, and it is impossible to apprehend the saving afforded without metering the amount consumed for a particular purpose." His company refused to meter the consumption, and turned the system out, in spite of over 50 p.ct. saving shown in another factory belonging to them, which did meter the gas used on a particular furnace. From this it must be clear that there are good reasons for dealing with this, or any new system, on the basis of its achievements.

Here are the figures with respect to mixtures of gas and air (dealing with a 560 B.Th.U. Oldham gas) published by Sir Dugald Clerk in Volume 85 of the Proceedings of the Institution of Civil Engineers in 1886.

Gas.	° C. observed.
1/15	806
1/14	1033
1/13	1212
1/12	1220
1/10	1557
1/8	1733
1/7	1792
1/6	1812
1/5	1595

From this table, the thoughtful reader can plot a curve, and convince himself that in order to attain high temperatures with gas firing, the most essential factor is the proportion between gas and air. For instance, you might go on burning gas *ad infinitum*, without ever attaining a temperature that will melt steel. On the other hand, if you get and maintain the right mixture, you can do so in twenty minutes, as I have done.

Here, then, are some many millions per annum to be picked up and shared between the consumer, the gas industry, the manufacturer, and the inventor, over and above the other benefits which complete combustion will confer on industry and the country generally. By standing aloof, and waiting sixteen years for the patents to elapse, they will, on town gas alone, between them have lost the opportunity of dividing any part of some two hundred millions sterling. It would seem worth while that the heads of the gas and other industries should meet to discuss these points.

The "One-Man" Sulphate Plant at Great Yarmouth.—Our attention has been called to the fact that the "one-man" sulphate of ammonia plant at the Great Yarmouth Gas-Works, described [*ante*, p. 288] by Mr. P. D. Walmsley, B.Sc., in his recent paper before the Eastern Counties Gas Managers' Association, is a Wilton plant, by the Chemical Engineering and Wilton's Patent Furnace Company, Ltd., who have devoted much attention to evolving a plant calling for the minimum amount of labour.

SOME MEANS OF IMPROVING HORIZONTAL RETORT SETTINGS.

Silica Retort Settings and Scrubber Standpipes.

By G. M. GILL.

IT is three years since the writer paid a visit to a number of American gas-works; and on looking through his notes a few days ago, he was reminded of some of the differences between American and British gas-works practice. In many ways it would not be correct to say that the American practice was superior, but in some directions notable progress has been made in the United States. Nothing impressed him more than the extent to which American engineers had adopted silica materials for their retort settings; the whole of the brickwork inside the shell of the settings being constructed of 95 p.ct. silica material.

The writer found that the American gas engineers, by using this material, were carbonizing an amount of coal in 6 to 8 hours which in this country would be carbonized in 10 to 12 hours. This generally was being done in works which the writer visited; and he can testify to the extremely high temperatures employed, and can safely say that, as the result of this considerable increase in retort output, much more gas was being produced on a given area. It is sometimes suggested that this shortening of the carbonizing period in America is due to a difference in the class of coal used. This can hardly be the case, as the writer can assert from his experience in carbonizing many thousands of tons of different varieties of American coals during the coal strike in 1921, when it was found that it took quite as long to carbonize these coals as ordinary qualities of Durham coal.

The substantial increase in the amount of coal carbonized in a given time is undoubtedly due to two factors; the main one being the higher temperature, and the other the greater conductivity of silica material. One engineer in America told the writer that the superior conductivity of silica material would alone account for an increased output per retort of about 15 p.ct., which figure the writer would not care to endorse without more experience. It is however, certain that a comparatively small percentage increase in the heats employed, as measured in the combustion chamber, will result in a much greater percentage increase in the amount of coal carbonized in a given time. To prove this point, the writer, for a period of three months, worked one retort setting at a temperature of 1400° C. in the combustion chamber, which was 100° higher than the normal temperature employed in the settings adjoining. The result experienced over this period proved that a 1-13th, or 7¾ p.ct., increase in the combustion chamber temperature resulted in an increase of 25 p.ct. in the amount of coal carbonized. It was, in fact, found that by employing this higher temperature the ordinary and normal charge, which in this case was 10½ cwt. of ten hours' duration, was completely carbonized in a period of eight hours; and this increase in carbonizing capacity continued to be experienced throughout the whole of the three months.

The same thing is being experienced in those coke oven plants where higher than normal temperatures are employed, for Mr. A. H. Middleton (Manager of the Consett Iron Company's coke-oven plant), in his paper before the Ceramic Society's meeting at Birmingham in October last, stated that in a test carried out at an American coke-oven plant, at which he was present, the carbonizing times for a similar amount of coal had to be varied in accordance with the temperatures employed as stated below:

Temperature.	Carbonizing Time.
1320° C.	15½ hours
1252° C.	18 ,,
1122° C.	24 ,,

It will be observed that with a temperature of 1122° C. the carbonizing time was 24 hours, but by raising the temperature to 1252° C., an increase of 11·5 p.ct., it was possible to increase the amount of coal carbonized by 33·3 p.ct., while, by raising the temperature by a further 68° C., to 1320° C., or an increase of 5·4 p.ct., the amount of coal carbonized was increased by an additional 16·1 p.ct. These figures are vouched for by Mr. A. H. Middleton, who is one of the leading coke-oven managers in this country. As he puts it, the output of a silica-brick oven worked at 1320° C. is over 50 p.ct. greater than the same oven worked at 1120° C. These figures corroborate the writer's experience related above, and would therefore indicate that the possibilities of improving horizontal retort-house plant before scrapping it should, at any rate, be carefully considered; as the fact that it is possible to increase so largely the output of gas in the same setting and on the same space in comparison with that previously produced by old plant, merits the careful consideration of every undertaking having extensions in view.

Before adopting silica material, it is important that engineers should bear in mind some of the essential facts in relation to this refractory. Insufficiently burnt silica material, if used in retort-settings, is likely to cause nothing but trouble; and too great care cannot be taken to ensure that the material which it is proposed to use has been properly burnt and is in other respects suitable for retort settings.

The great disadvantage in using silica material containing, say, 95 p.ct. silica, is to provide for the expansion which is experienced with this type of brick. It should be explained that with silica bricks there will, of course, be the ordinary thermal expansion, which will amount to something under 1 p.ct.; but in addition to this there will also be the permanent or after expansion, which may quite well amount to a further 1 p.ct. or more if the material is not sufficiently burnt in the kiln. The reason of this increase in size of silica is due to the conversion of the original quartz into tridymite or cristobalite, during which conversion the brick increases in bulk and decreases in specific gravity. If the brick is properly burnt to a sufficiently high temperature, and for a sufficiently long time, over 70 p.ct. of the quartz will have been converted into tridymite or cristobalite, and corresponding increase in bulk and reduction in specific gravity will have taken place.

The specific gravity of quartz is 2·65, of cristobalite 2·33, and of tridymite 2·27; while a well-burnt silica brick, if risk is to be avoided, should have a specific gravity of not more than 2·35—that is to say, if it is intended to employ very high temperatures of, say, 1400° C., or above, in the combustion chambers of the settings in which this material is to be used. It may be thought that in these circumstances there is a good deal of risk attached to the use of silica bricks, and undoubtedly there is, unless proper tests are made prior to its use. Several bricks should be taken from each consignment, and submitted to tests which will indicate the amount of after-expansion which is likely to be experienced in the retort settings. This may be done in two ways:

1. By heating the brick to a higher temperature than that to which it will be submitted in the retort setting. Such second burning will give a fair indication of the expansion to be expected. If at all excessive, it is clearly unsafe to use the brick, or the consignment from which it was taken. If small in degree, it is quite practicable to use strips of wood or millboard, or leave spaces in certain parts of the setting to allow for such expansion.
2. Have the sample bricks tested for specific gravity, by which means the percentage of conversion from quartz to tridymite or cristobalite may be ascertained, from the results of which tests the further expansion likely to be experienced in the setting will be indicated.

The writer attaches the greatest importance to the carrying out of such tests, and would not himself venture to use silica material and very high temperatures without first making out these tests.

Gas engineers can obtain a certain amount of information from placing silica bricks in their combustion chambers for a week or so, and by measuring these bricks before and after such second burning. Any change in size may then be noted, and if at all excessive such bricks would be unsatisfactory in use. It must, however, be borne in mind that the ordinary combustion-chamber temperature of, say, 1300° C. is a very low temperature at which to test 95 p.ct. silica bricks, and such practical test is only likely to be of use in demonstrating where bricks have been very badly burnt, and where excessive expansion is likely to be experienced.

The writer would not like to give the impression that there are too many risks in using 95 p.ct. silica material for retorts and cross walls to make it worth while, as with ordinary care the advantages are so great that it is bound to become a general practice in the future, as has been the case in the United States.

THE CONGDON SCRUBBER STANDPIPE.

Another direction in which the American gas engineer has made a definite change in the design of horizontal retort-settings, is in the increasing use of the Congdon scrubber standpipe in place of the ordinary ascension pipe. The writer saw several retort-houses with such standpipes in use, and was much impressed with their advantages, not only directly by avoiding the use of augers, but also from the point of view of benefits, to be derived from re-designing retort settings, which are rendered possible by the use of these standpipes.

All engineers, when designing settings, have been obliged to place the retorts, not where they would wish these put, but where there would be room for ascension pipes to be fitted. Ascension pipes practically fill-in the whole of the space from buckstay to buckstay, and as a result the width of horizontal settings in some cases has had to be increased to provide room for them. By using the scrubber standpipe the width of settings can generally be reduced; though this statement would hardly apply to some settings of sevens, eights, and nines, set in three vertical tiers, as in this type of setting there is frequently no more flue space between the retorts than is absolutely necessary. But in settings with two vertical tiers, reduction in width can be made. Greater facility in design is, therefore, one of the advantages of this system. With the scrubber standpipe in use, and designed as it should be with the shortest possible connecting piece between the mouthpiece and standpipe, the liquor flowing down the standpipe will keep it quite free from stoppage or deposit, and in practice maintains a perfectly clear passage for the gas from the retort.

It is probably realized that with two ascension pipes per retort in use, one pipe is often partially or wholly stopped, though this fact is not observed owing to the other pipe taking off all the gas as made. Where this is the case, there is a higher than normal pressure in the retort, and the disadvantages of single ascension pipes, such as splitting-up of the gas, and increased production of sulphur compounds and naphthalene, are experienced. In this connection the writer, in retort-houses with two hydraulic mains per setting, adopted the plan of shutting-off temporarily for testing purposes the gas outlet on one hydraulic main of each setting, and then made a record of the stopped and partially stopped ascension pipes. Many such stoppages can be observed where

this test is applied. Of course, this can only be done where two ascension pipes are fitted to each retort.

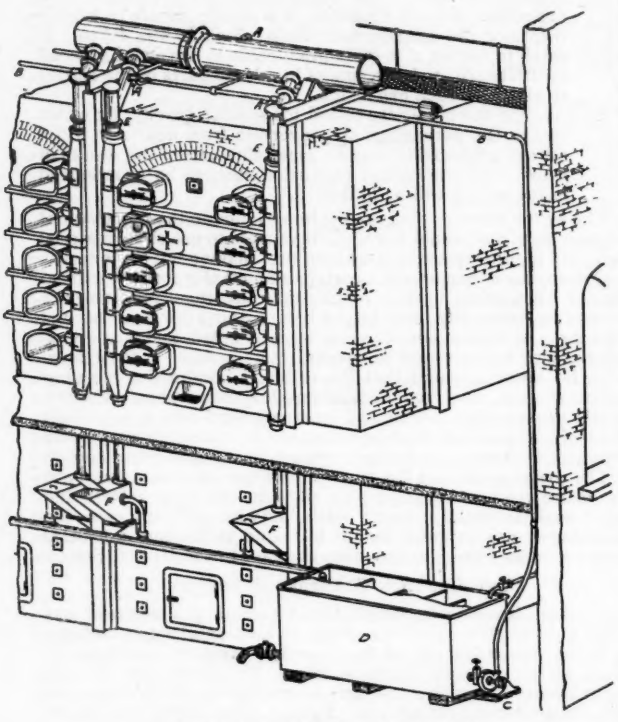
A considerable reduction in weight of metal can be made by using the standpipe system; and where the hydraulic mains are dispensed with, the standpipes can be connected directly to the foul main as is done in the United States—considerable capital outlay being thereby avoided.

When in America the writer questioned several engineers in regard to the effect on the gas of the additional cooling and washing to which it was subjected with the scrubber standpipe in use, and was informed that with this system the work of the condensers, washers, and scrubbers was materially reduced.

From the illustration included with this article the main principles of the system will be readily understood.

With such an arrangement in use, when the retort doors are open, the valves on such retort are closed; but when the mouthpiece doors are shut, the standpipe valves are immediately opened, and the retort is working without a seal, at whatever pressure or vacuum is being maintained in the foul main. Should one setting be shut down, isolating discs are used to put the scrubber standpipes out of action.

As an advocate of working retorts with unsealed dip-pipes, the writer sees in this system possibilities of working without seals to greater advantage than can be realized with the ordinary method in use. The well-known disadvantages of the hydraulic main seal have been discussed in technical circles for the past sixty years



Congdon Scrubber Standpipe System.

The above sketch shows the general arrangement of the Congdon scrubber standpipes, which are here shown attached direct to the foul main, thus enabling hydraulic mains and dip pipes to be dispensed with. Provision is made for spraying, as shown at A, both standpipes and foul main with a continuous flow of liquor maintained at a predetermined pressure by means of a relief valve on the delivery pipe B from the centrifugal pump C connected to the separating tank D. On the outside of each connecting piece between the mouthpiece and standpipe is fitted a valve actuated by means of a spindle (passing through a packed gland), and a hand lever placed outside the standpipe. Each standpipe may be isolated from the foul main by inserting a disc of metal at the point E. The spraying nozzles are removable; while facilities are provided for observing whether the nozzles are free, and means for clearing them if necessary. Seal boxes F, with hinge covers to facilitate removal of any deposits, are fitted at the bottom of each standpipe. Provision is made for unequal expansion of mouthpieces and standpipes by employing a socket and spigot joint on each connecting piece, and also by the use of slotted holes at the junction between mouthpiece and standpipe.

or more, and looking a few days ago through "King's Treatise on Coal-Gas," published in 1879, the writer was interested to notice the large number of ingenious methods described and illustrated in this book with the object of dispensing with the hydraulic-main seal. Experiences are there given of the increased amount of carbon which is deposited on retorts, as a result of the pulsating effect on the gas in the retort with seals in use; while the alternating pressure and vacuum conditions caused by the bubbling of the gas through the seals is clearly disadvantageous from the point of view of producing the best results from coal. It is generally agreed that the great disadvantage of the liquor seal is that there will be a larger amount of pressure in the retort during the first few hours of the charge than during the latter period of the same charge. As a result of this, there is a greater check on the gas when it is plentiful and rich in quality than there is when the quantity is small and the quality is low. This is an exact reversal of the conditions which should exist, and which can be obtained by dispensing with seals while carbonizing is proceeding.

The writer hopes in subsequent articles to call attention to other developments which are making greater headway in the United States than in this country.

ELECTROMETRIC TITRATION.

Our interest in the above subject has been aroused by Messrs. A. Gallenkamp & Co., Ltd., 19 to 21, Sun Street, Finsbury Square, London, E.C. 2, who have sent us their recently issued list of electrometric apparatus.

Electrometric methods of determining the concentration of the hydrogen ion, involving the use of the hydrogen electrode, have been employed for many years as a valuable means of chemical and physico-chemical research; but the value of electrometric methods applied to every day practical analysis has scarcely been fully appreciated. The method depends on the fact that if two electrodes of the same metal be placed in solutions containing the ion of the metal in different concentrations, and the two solutions joined in contact by means of a syphon, there will exist between the electrodes a potential difference, the measurement of which makes it possible to determine the ratio of the two concentrations. If one concentration is known, the other can be calculated from the observed electromotive-force. This result would be obtained by two hydrogen electrodes immersed in two solutions differing in hydrion concentration. In practical determinations the hydrogen electrode immersed in the known solution is replaced with a calomel electrode; this is a stable and reproducible half-cell, which can be connected with any solution whose concentration is to be determined.

As the difference of potential between the calomel electrode and a hydrogen electrode immersed in a solution normal with respect to hydrogen ions is known, the concentration of the solution under test can be calculated from the observed potential difference between the calomel electrode and the hydrogen electrode. There are many advantages attached to electrometric titration. Turbidity or colour of the solution have no effect on the accuracy of the measurements; it is possible to determine not only the total acidity, but the actual acidity at every point; the entire range of concentrations from normal acid to normal basic is covered, and the method is very precise.

Platinum, coated with platinum-black laden with hydrogen, and immersed in a solution containing hydrogen ions, acts as if the hydrogen were a metal in contact with its ions in the solution, and will exhibit a potential difference between solution and electrode, the value of which is dependent on the concentration of the hydrogen ions. There is no simple method of measuring this potential difference; but a practicable arrangement, whereby voltage values can be determined which have a known relation to the hydrogen ion concentration, can be obtained by the use of a calomel electrode, an electrode of platinum wire in contact with mercury, covered with calomel and overlaid with a solution of potassium chloride. This maintains a constant potential, so that changes in the over-all electromotive-force are due to changes in the hydrogen ion concentration of the solution surrounding the hydrogen electrode. This, converted into terms of concentration of the hydrogen, is sufficient to represent either acidity, neutrality, or alkalinity of the solution.

It is significant that several well-known manufacturing firms employ this method of titration, and the pamphlet of Messrs. Gallenkamp confirms us in the view that theory and practice are closely inter-related.

The Coefficient of Contraction in Gas Discharge.—Availing themselves of the opportunity given by the erection of a large dry gasholder, of a capacity of 20,000 c.m. (about 700,000 c.ft.), says "Engineering," Drs. Schwarz and Wengl, of the Gute Hoffnungshütte, made a series of measurements of the coefficient of contraction of nozzles formed in diaphragms of large-sized mains, up to 5 ft. in diameter. The actual pipe diameters were 595 mm., 995 mm, and 1495 mm (*Zeitschrift Verein. Deutsch. Ingenieure*). The nozzles were all supposed to be curved to circular arcs, but were not of perfect curvatures. They ranged in internal diameters from 346 mm. up to 1248 mm. The diaphragm diameters had similar extreme ranges. Pressures were determined in front of, and behind, the diaphragms at distances of 80 mm., 130 mm., and 450 mm. from the nozzles (roughly 3 in., 5 in., and 18 in. respectively). The rate of gas flow was determined and checked by leakage tests, before and after each series of measurements. The results lead to the empirical formula $\mu = 1 - 0{\cdot}368\sqrt{1{\cdot}15 - m^2}$, where μ is the coefficient of contraction, usually designated by C_c in this country, and $m = f/F$, *i.e.*, the ratio of the cross-section of the nozzle or diaphragm to that of the pipe. Up to $m = 0{\cdot}75$ the observations agreed with the formula, and gave an elliptic curve. When m became greater than 0·75, the agreement was less satisfactory. For $m = 1$, μ should also be 1. The actual coefficient observed was about 0·93. The coefficient of contraction appeared to be independent of the pipe diameter, at least up to diameters of 5 ft.

MANCHESTER DISTRICT INSTITUTION OF GAS ENGINEERS.

VISIT TO LIVERPOOL.

MEMBERS of the Manchester District Institution of Gas Engineers held their 195th quarterly meeting at Liverpool on Friday last, under the Presidency of Mr. R. E. GIBSON, M.Inst.C.E., Chief Engineer to the Liverpool Gas Company. There was an exceptionally large attendance; the prospect of the pleasure and information to be derived from a visit to the great city on the Mersey, and from an inspection of the Liverpool Gas Company's big works at Garston, having acted as a powerful magnet.

The meeting was held in the Exchange Hotel. Mr. H. Wade Deacon, C.B.E., J.P. (the Chairman of the Gas Company), was present, and gave the visitors a cordial welcome.

The minutes of the last meeting were submitted by the Hon. Secretary (Mr. Wm. Rogerson, of Middleton), and confirmed.

NEW MEMBERS.

The following new members were received: Mr. Claude Diamond, Engineer and Manager, Barrow-in-Furness; Mr. John Mottram, Engineer and Manager, Audley, Stoke-on-Trent, and Mr. Frederick Slater Hunter, Engineer and Manager, Ormskirk.

HONOUR FOR MR. KENDRICK.

The meeting, with one consent, decided to make Mr. H. Kendrick, late Engineer to the Stretford Gas Company, an honorary member.

Mr. KENDRICK expressed his grateful appreciation of the compliment paid him. He had served the Institution in almost all its offices, and been an active member for many years. He felt his position very keenly, he said, when he had to write to the Secretary, informing him of the change in his circumstances and placing himself entirely in the Council's hands; and when they decided to make him an honorary member, he felt very grateful indeed. He had hoped, he added, to live his life as a gas engineer. He thanked them, the President, the Council, and the members generally for allowing him to continue his membership of the Institution, the premier district institution in Great Britain.

THE LATE MR. W. CHEW.

The members rose in their places as a token of their respect for the late Mr. W. Chew, of Blackpool, and of sympathy with his family in their great loss.

MAINTENANCE COSTS OF CONTINUOUS VERTICAL RETORTS.

A paper on this subject was contributed by Mr. W. Buckley, Engineer of the Droylsden Gas-Works, Manchester. It gave the history of the retort plant at Droylsden from July, 1910, to May, 1921. The text of the paper and the discussion will be found on p. 414.

The PRESIDENT said they were very much indebted to Mr. Buckley for his interesting and practical paper. He was only sorry that the time for discussion was not longer; they had half an hour.

THE LUNCHEON.

The visitors were the guests of the Liverpool Gas Company at luncheon, Mr. H. WADE DEACON (Chairman of the Company) presiding.

The CHAIRMAN, in proposing "The Manchester District Institution of Gas Engineers," recalled its long history, its premier position among such institutions in this country, and expressed his high appreciation not only of Mr. Gibson personally and as Engineer to the Liverpool Gas Company, but of the honour done him by choosing him for the office of President.

Mr. GIBSON replied to the toast.

Mr. S. TAGG (Preston, Senior Vice-President of the Institution of Gas Engineers) proposed "The Liverpool Gas Company," and in so doing made graceful reference to the progressive character of the Company, and thanked them, on the meeting's behalf, for their hospitality and for permission to visit their works at Garston.

Mr. ALFRED TYRER (Vice-Chairman of the Gas Company) replied.

VISIT TO THE GARSTON GAS-WORKS.

The principal works of the Liverpool Gas Company are situated at Garston, and there the visitors went in the early afternoon; being conveyed from the hotel to the works in motor buses. The works are numbered among the largest in the kingdom. Not only for magnitude are they remarkable, but they compel admiration for orderliness and adaptability for their work. Flowers were blooming on one side of the works, and cleanliness and the absence of disagreeable fumes were notable features.

The visitors were conducted through the works in groups, under the leadership of Mr. Gibson, Mr. Ernest Astbury (Assistant Engineer), Mr. Samuel Carter (Superintendent of the Linacre Works), Mr. G. Haynes (Superintendent of the Athol Street and Eccles Street Works), Mr. William Fletcher (Superintendent of the Garston Works), Mr. J. Charnley (Superintendent of the Wavertree Works), Mr. F. E. Tooley (Superintendent of the Caryl Street Works), and Mr. W. Norris (Assistant Superintendent of the Linacre Works).

DESCRIPTION OF THE GARSTON WORKS OF THE LIVERPOOL GAS COMPANY.

Since the inception of the Liverpool gas undertaking in the year 1816, nine different gas-works have been owned by the Company. The first two were closed down long ago, being superseded by larger works on other sites; and the last works, at Fazakerley, were closed down immediately after being taken over from the Liverpool Corporation in 1915.

Of the six manufacturing stations now in operation, that at Garston was the last to be constructed, the first section being laid down in 1894. The Garston works are now the second largest belonging to the Company; the present manufacturing capacity being 7½ millions per day. There is ample provision for future extensions for many years, as the area of the land acquired is 32½ acres.

The first portion of the works consists of plant for the manufacture of carburetted water gas; and until the beginning of 1922, when the new coal-gas plant was started, the Garston works were probably unique in this country, and in Europe, as being a station where carburetted water gas only was made.

CARBURETTED WATER-GAS PLANT.

There are four sets, having a nominal capacity of 1,500,000 c.ft. each per day. Two of the generators are fitted with Messrs. Humphreys and Glasgow's mechanical roller grates, which greatly reduce the laborious work and discomfort of clinkering. Each grate is operated by a small hydraulic motor.

The coke for the generators is taken direct from overhead storage hoppers situated above the operating floor; and as it passes down a shoot to the generator charging door, the dust and fine breeze are removed by one of Messrs. Drake's patent "Cascade" screens.

Prior to the erection of the coal-gas plant at Garston, all the coke required for water-gas manufacture was brought by rail from the other manufacturing stations; the coke wagons being elevated to the coke store alongside the generator-house by means of a powerful hydraulic lift. The coke was put into the generators by means of coke skips on wheels, filled from shoots passing through the wall of the adjacent coke store. This method of handling the coke is being retained as a stand-by, though it may never be used except when the coal-gas plant is out of action.

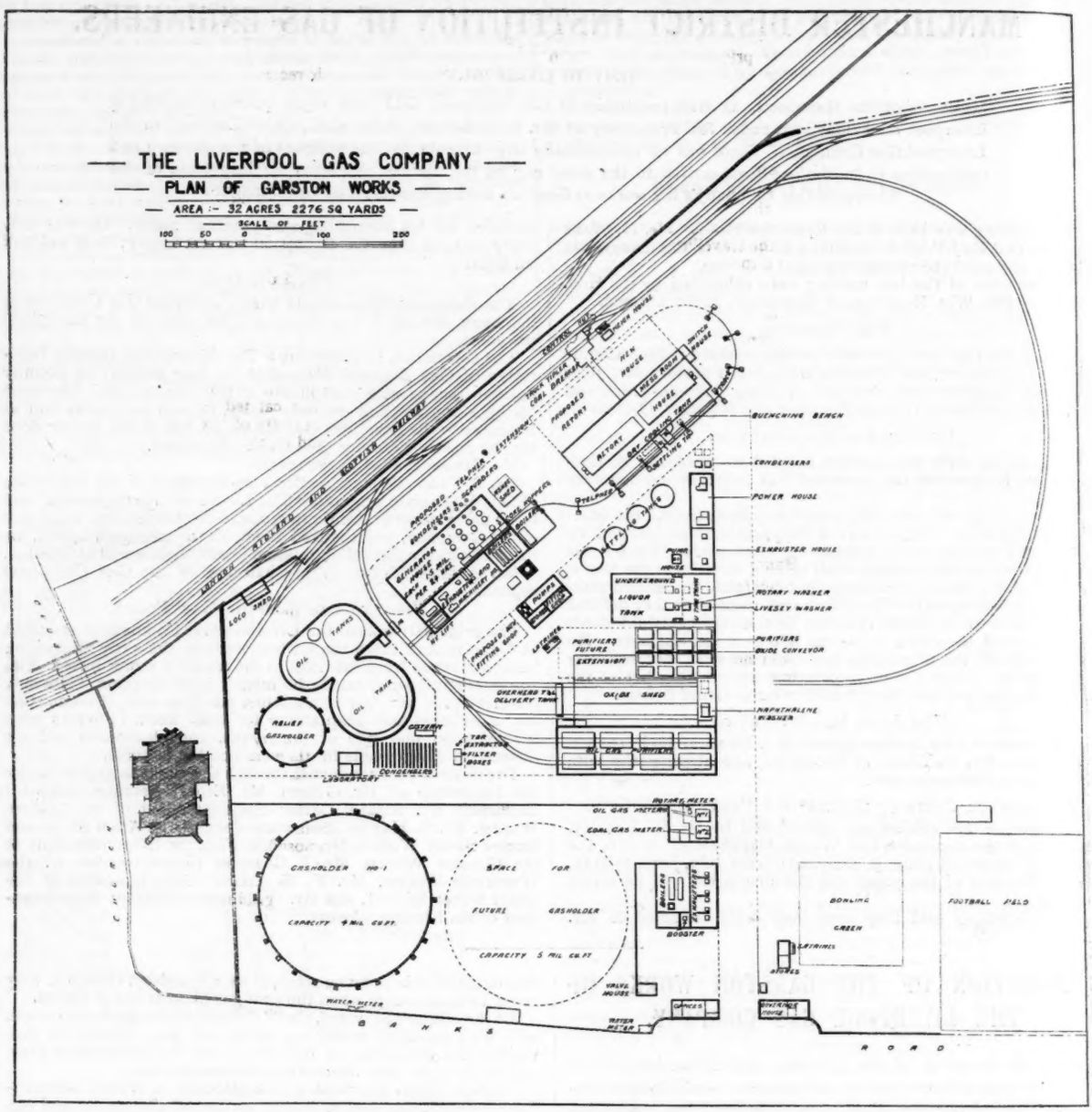
All the sets are provided, above the roof of the generator-house, with blast-products scrubbers, which are very effective in preventing the deposition of coke dust over the surrounding area, and at the same time deodorizing the waste gases.

Ample steam is provided by six Babcock & Wilcox boilers—five of which have each a heating surface of 1827 sq. ft., and one 2255 sq. ft. These boilers also supply the steam required by the engines of the exhausters and washers of the coal-gas plant. The furnaces of two boilers are fitted with Messrs. Meldrum's forced draught, and arranged for unscreened breeze as fuel.

The machinery room contains gas exhausters, pumps, blowers, &c. Two of the blowers are driven by belts from Tangye high-speed engines, and one direct by a De Laval steam turbine. At the end of the machinery room there is the hydraulic pump-house containing two pumps for supplying hydraulic pressure for the wagon lift, mechanical grates, &c. The hydraulic accumulator is situated near-by, at one end of the generator-house. Four settling tanks deal with the foul water.

The scrubbing and primary condensing plant is situated outside the generator-house; the condensers being of the vertical water-tube type. The gas afterwards passes through cast-iron vertical pipe condensers before entering the relief holder. In the first section of the pipe condensers, the gas flows up one pipe and down the next, and so on. When the second section was added, a change was made in the design, with the object of increasing the efficiency. The gas in this section flows up one pipe and then down the next three pipes in parallel; then up a single pipe, and down three again; and so on. By this means, the speed of downward flow is greatly decreased, and the cooling effect greatly increased. In order to remove the fine tarry vapour, the gas is drawn by the exhausters from the relief holder through a pair of filter boxes, 10 feet square, which are filled with layers of broken clinker, carefully screened and graded to different sizes; the gas flowing through a coarse layer first and finishing with the finest. These filter boxes are very efficient in removing the bulk of the tar, but do not remove the last traces. This is effected by passing the gas through a Carter's "Hurricane" tar extractor between the exhausters and the purifiers.

The purifying-house contains eight purifiers arranged in two sets of four boxes each. Each box is 40 ft. by 20 ft. by



5 ft. 6 in. deep, and charged with oxide of iron. On leaving the purifiers the gas is passed through a rectangular station meter, 125,000 c.ft. per hour capacity, and/or a rotary meter working in parallel with same. The connections of the rotary meter in relation to the station meter are so arranged that, when the make of gas will allow, the accuracy of the registration of the former can be checked by working the meters in series.

At the outlet of the meters the carburetted water gas is mixed with coal gas, which not only consists of that manufactured on the works, but also that pumped from the Athol Street, Caryl Street, and Wavertree stations; and the mixture then passes into the large gasholder.

In connection with the Garston works, special mention should be made of the 6 in. oil pipe line, laid in 1910 from the Stalbridge Dock through the streets to the storage tanks at the works—a distance of about half-a-mile. The pipes are of steel $\frac{7}{16}$ in. thick, lap welded, and were tested to a pressure of 1800 lbs. per sq. in. They are covered with Hessian cloth and coated with a tar preparation. By means of flexible connections at the dock quay, the pumps of the oil ships are connected to the pipe line, and a large cargo (say, 5000 tons) can be discharged and placed into the Company's tanks in the course of a few days at practically no expense. The pipe line is also used for filling tank-barges, which are employed to convey oil down the river and canal to the Linacre works. The four oil tanks at Garston have a total capacity of 1,782,500 gallons, or 6856 tons. They are surrounded by moats built in brick and cement. The bottoms of the steel tanks are all accessible on the underside for inspection and painting; being supported by a number of steel joists resting on a series of brick walls built parallel to each other.

Coal-Gas Plant.

This plant was erected in 1920-21, and gas-making started in March, 1922. The retort-house is a steel-framed structure with 9 in. brickwork panels, the piers being 18 in. thick. The internal dimensions of the house are 198 ft. 6 in. long by 60 ft. wide. The height from the ground floor level to the eaves is 58 ft. 3 in., and the height of the roof from the eaves is 18 ft. 9 in.

The charging and discharging stages are supported independently of the buckstays and ironwork of the retort benches, and space is left for expansion of the settings between the floors and the firebrick work, thus avoiding thrusts on the main walls of the building. The floors are constructed of concrete and expanded metal—the charging side being finished with a topping of granite chippings and cement, while the discharging stage is paved with hard burnt brindled bricks.

There are two benches of horizontal retorts, each of seven settings of ten retorts. The retorts (which are arranged in two rows of five tiers) are of ∩ section 24 in. by 18 in. by 22 ft. long. Each setting has one deep producer of ample capacity to carbonize 17½ cwt. per retort in 12 hours. Two 7 in. ascension pipes are fitted to each retort. These have proved satisfactory; for stopped pipes and thick tar in the hydraulic mains are unknown.

The hydraulic mains are of special section. At the back of each there is a cleaning trough or chamber, having openings in the top plate through which the hydraulic mains may be examined or cleaned without interfering with the operation of gas making. These openings are fitted with cast-iron frames and covers. Each section of the hydraulic mains has its own tar main and tar tower—the latter having the usual weir valve for regulating the seal of the dip pipes. The vacuum in the hydraulic mains of each bench is controlled by a retort-house governor.

Coal Handling Plant.

The coal is received into the works by sidings connected with

the Garston branch of the L.M. & S.R., and the wagons are discharged by a rotary tippler into a hopper with bottom doors leading to the coal breakers; the wagons being clamped in the tippler by electrically operated gear prior to tipping. Each breaker has a capacity of 40 tons per hour, and delivers into a gravity bucket conveyor, which elevates the broken coal into the retort-house and deposits it in a shoot feeding the tipping tray conveyors for filling the continous coal bunkers, the latter having a capacity equal to 48 hours' supply.

Stoking Machine.

This is a Fiddes-Aldridge five-tier simultaneous charging and discharging machine, with a special chain designed for putting into the retorts large charges, suitable for 12-hour work. Separate gear and motor are arranged for the travelling motion. The machine, as it travels from one retort to another, receives coal through automatic hopper doors fitted to the bottom of the continuous coal bunkers.

Coke Machine.

On the discharging side, a "G.N." patent coke handling machine has been installed. The main feature of the machine is a tube of special construction, through which the coke slides on being pushed out of the retort. The coke, after leaving the machine, passes through openings in the retort-house walls (fitted with balanced sliding doors) on to the inclined quenching bench outside. The coke slides throughout its journey, and is not allowed to fall at any point between the retort and the quenching bench. The production of breeze is thus to a great extent avoided. The work is done expeditiously, and with a minimum of discomfort to the men. The machine is also used for charging the producers, although in this installation it was not designed for the purpose.

Quenching Bench.

The bench (which is inclined at an angle of 35 degrees) is constructed of expanded metal and concrete supported by a structure of R.S. joists, &c., and paved with Buckley firebricks. The flow of the coke into the skips is regulated by the gates which are hung horizontally, also counterbalanced and held by a special catch when closed. The coke, after being thoroughly quenched by water from hose-pipes, is allowed to enter the skips, in which it is carried by the telpher to the storage hoppers in the water-gas plant. All the surplus water from the quenching bench is collected in a brick sump beneath the bench and used again, being returned to the hosepipes by an electrically-driven centrifugal pump

Dry Cooling Plant.

This plant is situated at the end of one of the quenching benches near the middle of the retort-house. The steel containers, which are fitted at the lower end with cast-iron mouthpieces with self-sealing lids, are enclosed in a ferro-concrete water tank. Water is circulated round the containers, the contact with same being increased by wooden boards fixed in the tank in such a manner as to increase the length of flow between the water inlets and the overflow. After the coke from the retorts has been transferred direct to the container by the coke machine, the steel sliding-door provided at the upper end of the container is closed. Air is thus practically excluded, and the coke, being cooled without contact with water, is superior in quality, free from moisture, and of a bright silvery grey colour.

Telpher Plant.

The coke is transported by the telpher either to the storage hoppers in the generator-house of the carburetted water-gas plant or to the stock heap in the yard. The main particulars of this plant are given in the following table:

Maximum span		69 ft.
Length of track		608 ft.
Height of track		52 ft. 6 in.
Maximum radius		64 ft.
B.H.P.	Lifting motor	18
	Travelling motor	6·5
Capacity of skip, cwts.		25
Speed of lifting (feet per minute)		70
Speed of travelling (feet per minute)		500

Provision is now being made in the coke store of the carburetted water-gas plant for screening and loading coke direct from the telpher skips into railway wagons.

Condensers.

There are two of Clapham's patent "Eclipse" water-tube condensers, each having a capacity of 1¼ million c.ft. of gas per 24 hours. Each condenser consists of a body or tower formed of cast-iron plates, containing 342 1⅞ in. wrought-iron tubes, each 21 ft. long and fixed vertically. The total cooling surface of each condenser is over 3420 sq. ft.

Exhausters.

Adjacent to the condensers is the exhauster and power house. The exhausters are of the four-blade type, and driven by horizontal steam engines. Each set has a capacity of 125,000 c.ft. per hour.

Electrical Plant.

The whole of the coal-handling plant, stoking, and coke machines, telpher transporter, water pump, and oxide conveyor in purifying house, are electrically driven by direct current at 220 volts, generated in the power-house.

There are two dynamos. The larger, consisting of a 88·6 KW. machine driven by a 132 B.H.P. twin cylinder Crossley gas-engine, is used for the day load; while the smaller, a 50·3 KW. machine, coupled to a 75 B.H.P. National gas-engine, is run during the night and week-end when the coal-handling plant is not working.

Automatic compressed air starters are fitted to each engine; the compressor and an air receiver, &c., being fixed in one corner of the power-house.

A cast-iron water tank erected above a portion of the building is utilized for cooling the supply of water to the cylinder jackets.

The main switchboard consists of three dynamo panels and one circuit control panel—the fittings including Kelvin ammeters and voltmeters. The distribution board is fixed in the switch house at one end of the retort-house.

Washer and Scrubber.

The gas, after leaving the exhausters, is passed through a Livesey washer of 2½ million c.ft. capacity per day, and then through a Whessoe rotary washer-scrubber. The strong liquor from the scrubber passes by gravity into the washer.

Liquor and Tar Underground Storage Tanks.

Under the scrubber yard are the underground liquor and tar storage tanks and separators. These are rectangular tanks, made of brick and puddle, the puddle being 18 in. thick. The top is constructed of brick arches carried by the cross and division walls of the tanks. The capacity of the tanks will be sufficient to accommodate the tar and liquor from the next section of coal-gas plant to be erected, in addition to present requirements.

Purifiers.

There are four purifiers, each 48 ft. by 32 ft. by 6 ft. deep, fixed above ground with revivifying floor beneath, and covered with steel roofing supported by steel stanchions; the sides of the building being open. Each purifier has four covers of the Green type fitted with Milbourne's patent fasteners. A Weck's centre valve controls the passage of the gas through the boxes. The direction of flow is downwards.

In order to minimize the nuisance caused by the smell of foul gas which escapes when a purifier is first opened for changing the oxide, each of the purifiers has a valve and connection joined up to a 3 in. main leading to the inlet of exhausters. The valve is opened, after the purifier has been shut-off, when the gas locked in the vessel will be at (say) 20 in. pressure. This pressure is reduced by the exhauster to nearly level gauge, when the valve is closed, and the purifier is then brought to atmospheric pressure by opening a blow-off cock leading to a vent pipe which is carried well above the purifying house roof. The covers are then removed without any inconvenience to the men.

After the purifier has been filled with fresh oxide and the covers replaced, the air that is enclosed is removed by allowing clean gas from an adjacent purifier to enter through the inlet main and opening the valve of the connection leading to the works exhauster. In this way, the gas gradually replaces the air, which is withdrawn and utilized for revivification of the oxide in the other purifiers. This arrangement has been used at Liverpool for the past 20 years with great success. The purifying material is elevated and conveyed to the shoots used for charging the purifiers by means of a gravity bucket conveyor, which also feeds a disintegrator through which the material is passed before being revivified.

Naphthalene Washer.

Near the purifying house a Holmes rotary washer-scrubber is being erected for the removal of naphthalene from the gas. Gas oil will be the liquid used.

Station Meter.

The station meter is of the usual type with rectangular case, and has a capacity of 125,000 c.ft. per hour. It should be pointed out that in planning and erecting the coal-gas plant provision has been made for doubling the capacity of the plant as economically as possible at some future date.

Gasholder.

This is the largest of the Company's holders, having a capacity of 4 million c.ft. There are three lifts—the outer being 212 ft. 6 in. in diameter by 40 ft. deep. The tank is an annular one cut out of the solid sandstone rock by blasting. The sides of the excavation are lined with brickwork in cement, and rendered watertight by a 1 in. thickness of asphalte, protected on the waterside by 9 in. of brickwork.

Distributing Exhausters.

There are three pairs of exhausters, each having a capacity of 150,000 c.ft. per hour. Each pair is driven by one engine. One pair is employed for pumping coal gas through a connecting main from the Athol Street, Caryl Street, and Wavertree works, and mixing same with the coal gas and carburetted water gas made at Garston, in the inlet main to the gasholder. The other two pairs return the mixed gas from the outlet main of gasholder through another connecting main to the Caryl Street and Wavertree works for distribution through their station governors.

Booster.

In order to reduce the oscillation in the outlet main from the gasholder caused by the distributing exhausters, a turbo-driven booster of 600,000 c.ft. per hour has been installed, which maintains a steady pressure on the inlet main to the station governors. An automatic governor is provided, which opens in the event of the booster failing and pressure in the inlet main to the station governors becoming less than that thrown by the gasholder.

Station Governors.

There are two station governors controlling the supply to districts in South Liverpool and Garston.

Recreation Ground.

A bowling green and large football field are provided for the employees; also recreation room, mess rooms, club rooms, &c.

Sidings.

There are nearly two miles of railway track on the works, and two locomotives (one in reserve) deal with the coal, coke, and other traffic. The locomotive shed is situated at the north corner of the works.

Contractors.

The contractors for the coal-gas plant were mainly as follows:

Messrs. Gibbons Bros., Ltd.—Carbonizing plant and steel framing for retort-house.

Messrs. Babcock and Wilcox, Ltd.—Coal-handling plant, wagon tippler, and boiler.

Messrs. Aldridge and Ranken — Stoking machine, coke machine, and dry cooling chambers.

Messrs. Strachan and Henshaw, Ltd.—Telpher.

Messrs. The Electric Construction Company, Ltd.—Electrical plant.

Messrs. Newton, Chambers, & Co., Ltd.—Purifiers.

Messrs. Clapham Bros., Ltd.—Condensers.

Messrs. Wm. Thornton and Sons, Ltd. — Underground tanks.

The Bryan Donkin Company, Ltd.—Exhausters.

The Whessoe Foundry and Engineering Company, Ltd.—Washer-scrubbers.

Messrs. R. & J. Dempster, Ltd.—Livesey washer.

THE MAINTENANCE COSTS OF CONTINUOUS VERTICAL RETORTS.

VERTICAL RETORT PLANT AT DROYLSDEN, MANCHESTER, JULY, 1910, to MAY, 1921.

By W. Buckley, of Droylsden.

[A Paper read at the Meeting of the Manchester District Institution of Gas Engineers on Friday, May 11.]

Costs of Maintenance—Notes, and Comments.

It will perhaps be as well if I preface my remarks by an explanation of the period taken for the purpose of this communication—viz., July, 1910, to May, 1921. As you are all aware, the Droylsden works are a very small section of the Manchester Corporation gas undertaking, and owing to their size have been, and are still to a certain extent, used as an experimental station. This is the reason why the first installation of Glover-West verticals was erected at these works. Being the first of its kind, it naturally contained most of the shortcomings inherent in a new plant of whatever type. I mention this because it must be taken into consideration when you come to study the results.

The plant was put into operation in July, 1910, and the results of the experimental work carried out were embodied in a paper, "The Scientific Carbonization of Coal," read by our late Engineer, Mr. J. G. Newbigging, M.Inst.C.E., at the meeting of the Institution of Gas Engineers held in Glasgow in May, 1911. One section (No. 2) was rebuilt—*i.e.*, the retorts and portions of the silica lining were renewed—in 1915, and the other (No. 1) in 1916. No. 2 bed should have been rebuilt in 1920; but pressure of work prevented the contractors from carrying this out, and the bed worked through until May, 1921.

The Gas Committee had decided that, as the plant was of an experimental character, it should be brought up to date when rebuilding, and the latest improvements introduced—*e.g.*, the retorts should be of a different cross section and worked in units of two, overhead collecting mains installed. and, as a result, a new foul main and retort-house governor provided. It had been decided to carry out this work in two sections, and arrangements were made with this end in view. But the coal strike intervened, and the whole of the plant was closed-down in May, 1921; the gas for the district being supplied from the other stations. Hence the period July, 1910, to May, 1921. It would have been a mistake if advantage had not been taken of this almost unique opportunity for tabulating costs over a definite period.

The genesis of the paper lay in a desire on the part of the writer to know something definite regarding the cost of maintenance of the various parts of the plant; but though the question had been asked, those approached would not, or more likely could not, give the required information. I am not surprised at this, because unless careful weekly records are kept, the amount of work entailed in obtaining full information of this character is greater than most men care to undertake. It is not possible to include detailed lists of the various items of expenditure, and no useful purpose would be served by so doing. I have, however, epitomized the information extracted from the various books into material, labour, &c., and have then calculated the results on the basis of the coal carbonized, &c., during the period under review.

Period Worked by the Settings.

Tables Nos. I. and II. give the period of working of each setting.

Table No. I.—*No. 1 Bed.*

Gas Making Commenced.	Let Down for Repair.	Days Worked.	Notes.
July 12, 1910 .	Aug. 9, 1912	757	Two retorts cracked. Producer in bad condition.
Nov. 13, 1912 .	Feb. 26, 1916	836	Two retorts in bad condition, 3 worm shafts straightened and 3 top-halves of extractor worms replaced.
		1593	

Gas making suspended from April 28 to May 2, 1913.

Retorts scurfed every eight weeks. Time occupied by scurfing, 36 hours = 2½ p.ct.

Each retort scurfed 26 times. 26 × 8 = 208 scurfings.

Coke elevated for filling retorts after scurfing, 208 tons.

Working days:

1593 − 5 = 1588 − (2½ p.ct = 39·7 days) = 1548 days.

After Renewing the Retorts.

Gas Making Commenced.	Let Down for Repair.	Days Worked.	Notes.
Jan. 15, 1917 .	April 28, 1918	469	Retorts podged and washed.
Nov. 20, 1918 .	March 28, 1919	128	Retorts podged and washed.
May 19, 1919 .	March 1, 1921	650	Two retorts cracked; these were repaired. Retorts in good condition except the two which had been patched.
		1247	

Each retort scurfed 20 times. 20 × 8 = 160 scurfings.

Coke elevated for filling retorts after scurfing, 160 tons.

Working days: 1247 − (2½ p.ct. = 30·1 days) = 1216 days.

No. 1 Bed.

No. 1 bed was put into operation on July 12, 1910, and worked continuously until Aug. 9, 1912—a total of 757 days. Very little repairs were necessary to the retorts, podging of the cracks and washing being all that was required. The producer, however, had suffered considerably; in fact, it had been necessary to build a buttress wall on one side owing to the lining having been burned through, and the producer wall itself had become very thin. The bed was put into operation again on Nov. 13, 1912, and worked until Feb. 26, 1916 (a period of 836 days), when it was put-down for renewal of the retorts, and, where necessary, repair of the silica lining.

Gas making was suspended from April 28 to May 2, during which time a new type of collecting main was installed. The time worked by the retorts during the two periods was 1593, less 5, days. The retorts are scurfed every eight weeks, and the time occupied is 36 hours, or 2½ p.ct.

We therefore have 1593 − 5 = 1588 (less 2½ p.ct. = 39·7 days) = 1548 working days. The amount of coke elevated for filling the retort after scurfing is about 1 ton, the total during the first period being 208 tons.

In addition to rebuilding the retorts, it was necessary to straighten three worm shafts and fix three new worm tops; these worm tops had been broken by the men dropping material down the retorts during dismantling. Needless to say, the manager was away on holiday when this occurred. After renewing, the retorts were put into operation on Jan. 15, 1917, and worked as shown, with periods off for repair, till March 1, 1921, when they were let-down for reconstruction, as mentioned in my opening note.

The working days were as follows:

1247 − (2½ p.ct. = 30·1 days) = 1216 days.

Coke elevated for filling retorts during the second period was 160 tons. Total retort days worked during the two periods—

2764 × 8 = 22,112 retort days.

Total coke elevated for filling retorts after scurfing, 368 tons. When let-down for reconstruction, the retorts were, with two exceptions, in fairly good condition.

Table No. II.—*No. 2 Bed.*

Gas Making Commenced.	Let Down for Repair.	Days Worked.	Notes.
Oct. 8, 1910. .	June 2, 1911	237	Two retorts badly cracked, these were podged. Two worm tops renewed.
Nov. 7, 1911 .	March 7, 1912	139	Two retorts were patched.
Aug. 8, 1912 .	March 21, 1913	214	Patched retorts were again repaired, and floor tile renewed.
Oct. 29, 1913 .	Sept. 17, 1914	284	Setting dismantled for renewal.
		874	

Gas making suspended from April 28 to May 2, 1913.

Each retort scurfed 15 times. 15 × 8 = 120 scurfings.

Coke elevated for filling retorts after scurfing = 120 tons.

Working days: 874 − (2½ p.ct. = 21·85 days) = 852 retort days.

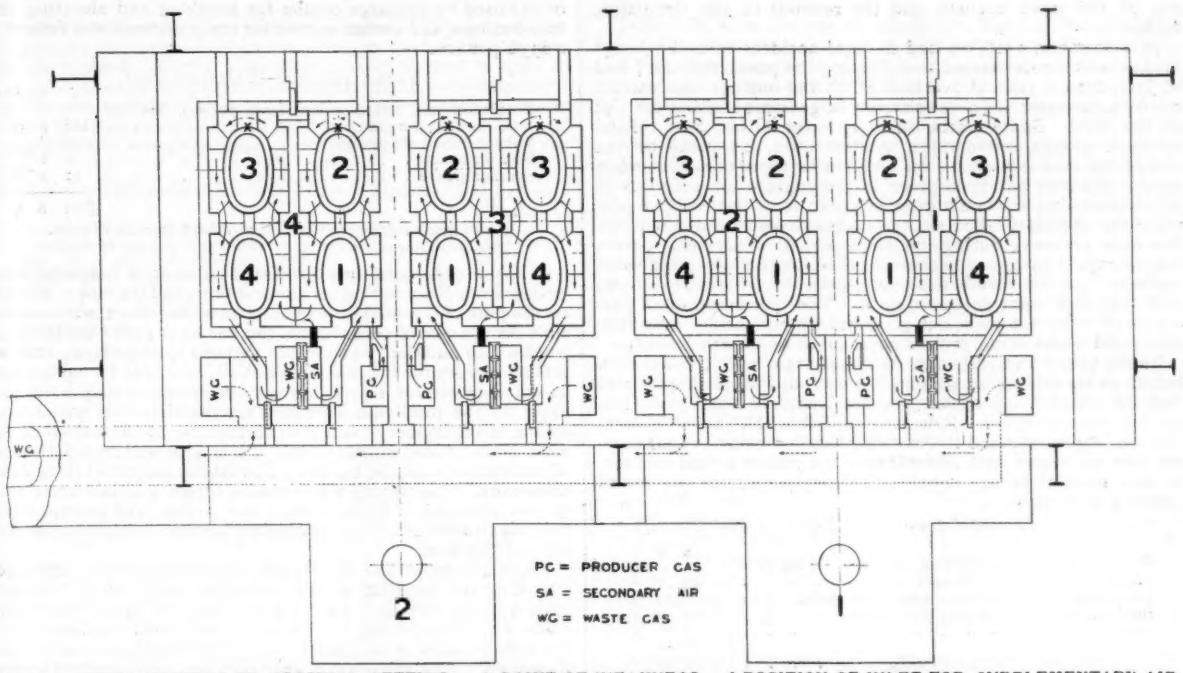


FIG. 1.—CROSS-SECTION OF ORIGINAL SETTING. X POINT OF WEAKNESS. I POSITION OF INLET FOR SUPPLEMENTARY AIR.

After Renewing the Retorts.

Gas Making Commenced.	Let Down for Repair.	Days Worked.	Notes.
Dec. 3, 1915 .	April 9, 1917	481	Retorts podged and washed.
Oct. 17, 1917 .	May 20, 1919	581	Two retorts with small crack; these were podged and washed.
Nov. 1, 1919 .	May 17, 1920	199	Two retorts were patched, the remainder podged and washed.
July 30, 1920 .	May 9, 1921	283	Two retorts had been out of action for a few days before letting down for reconstruction.
		1544	

Each retort scurfed 27 times. 27 × 8 = 216 scurfings.
Coke elevated for filling retorts after scurfing = 216 tons.
Working days: 1544 − (2½ p.ct. = 38·6 days) = 1505 retort days.

No. 2 Bed.

For experimental purposes, fireclay goods and retorts from a different firm were used in this setting, which early in its life showed signs of weakness. On closing down for the first time, it was necessary to podge two of the retorts which had developed rather large cracks at one particular point. In addition it was necessary to replace the top halves of two of the extractor worms.

When closing down the plant, the late manager, with the idea of cooling the setting very slowly, left coke in the retorts. Either the discharging doors were not tight, or the secondary-air circulating chambers were leaky, but the coke in two of the retorts attained such a high temperature that the tops of two of the worms were destroyed. When closing down, it is desirable to empty the coke from the retorts, see that the discharging doors are tight, and leave the balls turned up. Do not draw the fire from the producer, but allow it to burn away slowly. All producer and secondary-air dampers are left as when working, but the main chimney damper closed down to about ¼ in.

I will not weary you with a repetition of details; but reference to table No. 2 shows that this setting was put into operation on Oct. 8, 1910, and worked till Sept. 17, 1914. The total days worked was 852. The coke elevated for filling the retorts after scurfing was 120 tons. After renewing, the retorts worked from Dec. 3, 1915, till May 9, 1921. When finally put out of action, six of the eight retorts were in working order. The total days worked was 1505. The coke elevated for filling retorts during the second period was 336 tons. The total days worked during the two periods was 18,856. The total coke elevated for filling the retorts after scurfing was 336 tons.

From the data quoted, it will be found that the total retort days worked by the two settings during the period under review was 40,456 days, or an average of about 1250 days per retort. The coal carbonized during the period being 99,297 tons, we obtain an average throughput per retort of 2·45 tons per diem. An examination of the tables shows that this average of 1250 working days per retort is due to the failure of the material used in No. 2 setting. From the behaviour of No. 1 and No. 2 after re-setting, one would expect an average life of about 1500 days per retort. With a daily throughput of 2·45 tons, this represents a carbonizing capacity of 3375 tons of coal per retort life. The total coke elevated for filling the retorts was 704 tons.

It has been mentioned that, when let down for repair and renewal, there were one or two retorts in each bed which were cracked and had first to be well podged and later patched. If you refer to fig. 1, you will find the point marked with a cross. This was about 3 ft. from the bottom of the retort, or in the first combustion chamber. There must be an explanation for this weakness, and perhaps those who have had experience of verticals will favour us with their views on the matter. If you again examine fig. 1, you will notice that, the retorts being worked in units of four, there was a rather long and somewhat tortuous travel for the products of combustion; and we had some difficulty in the early days in maintaining a good carbonizing temperature in retorts Nos. 3 and 4 without unduly heating retorts Nos. 1 and 2. This difficulty, however, was overcome after the plant had been working a few months by cutting an opening from the secondary air flue to a point opposite the end of the division wall between the two pairs of retorts. The position of this opening is marked on the illustration by a black patch. In working, the practice was to admit an insufficient supply of secondary air at the point of entrance into the combustion chambers; the result being that a small volume of unburned producer gas was carried along with the products of combustion to the end of the division wall. An additional supply of what we termed supplementary air was admitted at this point to complete the combustion; and by an adjustment of dampers, it then became an easy matter to maintain the same temperature in retorts Nos. 3 and 4 as in retorts Nos. 1 and 2. I understand that, where the retorts are built in lines of four, this system has now been standardized, and a patent has been taken out covering the principles involved.

TABLE NO. III.—*Maintenance and Repair of Gas-Engines.*

Three Engines.

	£	s.	d.
Spare parts: One new liner and piston for each engine, and one new circulating tank for each engine . .	129	16	7
Gas-engine oil (about 1150 gallons)	93	2	0
Labour	62	10	1
	£285	8	8

Coal elevated into storage hoppers	99,297 tons
Coke extracted from retorts	63,755 ,,
Coke elevated for producers	11,668 ,,
Coke elevated for filling retorts	704 ,,
Total material handled . . .	£175,424 tons

Cost, 0·390d. per ton.

Repair and Maintenance of Gas-Engines.

There are three gas-engines; two 4½ B.H.P., K type, and one 17½ B.H.P., P type, National engines. The small engines are used for coke extraction, and are run for a week alternately. The engines are changed over on Monday morning; and, as soon as out of action, the engine which has been running has the valves and and valve seatings cleaned and left ready for starting up. The gas-burner heating the ignition tube is never turned off unless some special repair is required. The large engine is used for breaking and elevating coal, and also for elevating coke for the producers and retorts. All three machines have run very well and given little trouble. The main items of expenditure have been one new liner and piston for each engine, a new pulley on

one of the small engines, and the renewal of the circulating tanks.

In December, 1918, we had a slight accident with the larger engine, which necessitated straightening the piston rod, &c.; and in July, 1920, a general overhaul of all the engines was carried out by a specialist. These relatively large items account for £92 of the total. Spare parts, such as valve boxes, cam rollers, spindles, springs, piston rings, ignition tubes, &c., make up the rest of the sum expended. In addition to those occasions when special attention has been given to the engines for purposes of adjustment, &c., or when a fitter has been sent, and we have provided the necessary labourers, the engines have been debited with one hour per week during the whole period. This easily covers the time spent on changing-over and cleaning the valves and valve seatings. As this work is done systematically, it naturally follows that very little time is spent on it. The consumption of gas-engine oil is rather high, but good lubrication means easy running; and we have not yet had occasion to renew any bearings.

I have stated the gallonage as about 1150, having taken each barrel as containing 40 gallons. It was also surprising to find that oil, which in 1910 cost 30s. per barrel, in 1920 cost 140s. for the same quantity. Reference to Table III. shows the total cost as £285 8s. 8d.; and the material handled being 175,424 tons, the cost for repair and maintenance is equal to 0·390d. per ton, or little more than one-eighth of a penny per engine per ton of material dealt with.

TABLE No. IV.—*Maintenance and Repair of Coal Elevator.*

	£	s.	d.
Total material used, including new chain for top drive	54	0	11
Fitters' time repairing elevator	20	5	0
Labour at works on elevator during the period	50	19	9
Belting, laces, and leather preservative	61	0	9
Stauffer grease	4	10	9
Total	£190	17	2

Coal carbonized, 99·297 tons; 0·461d. per ton.

TABLE No. IV.—COAL ELEVATOR.

The coal elevator is a portion of the plant which has required very few renewals; a new chain for the top drive, and new brasses for the breaker, fitted in February, 1920, being the main items. Two new clutches, a few slippers and spare buckets, and new plates round the breaker pit make up the expenditure for materials. Apart from fitters' time during repairs, the main item in labour at works is for tightening and repairing belts, and attention to the shoots into the coal hoppers. The belting includes the belts used on the small engines for extractor gear. I have included this because I could not, with certainty, separate the various belts, so a small fraction of a penny is added to the coal-elevator cost and taken from the extractor gear. Total cost for renewals, repairs, and maintenance works out to 0·461d. per ton of coal carbonized.

TABLE No. V.—*Gas Used by Large Engine for Breaking and Elevating Coal, Elevating Coke for the Producers and for filling Retorts after Scurfing.*

	C.Ft.		d.		£	s.	d.
July, 1910, to March, 1914	1,703,200	at	12·50	..	88	14	2
March, 1915	415,000	at	12 85	..	22	3	7
March, 1916	426,400	at	10·50	..	18	13	1
March, 1917	381,400	at	13·56	..	21	11	0
March, 1918	467,500	at	13·27	..	25	17	0
March, 1919	522,800	at	15·08	..	32	17	0
March, 1920	514,600	at	17 97	..	38	10	7
March, 1921	582 600	at	26·31	..	63	17	4
May, 1921	65,400	at	37·81	..	10	6	3
	5,078,900				£322	10	0 = 15·24d. per thousand.

Coal carbonized	99,279 tons
Coke elevated for producers	11,668 ,,
Coke elevated for retorts	704 ,,
Total material elevated	111,651 tons

Gas consumed per ton of material elevated = 45·48 c.ft.
Cost of gas for coal breaking and elevating, and elevating coke for producers and retorts = 0·693d. per ton.

Table No. V. requires very little explanation. Prior to 1914, we did not receive a copy of the account submitted for gas consumed at the station; and rather than put the department concerned to a considerable amount of trouble to find the figures, I have taken them from the meter book kept at the works. There are separate meters for the large and small engines; and the state of all meters recording consumption at the works is taken by the inspector for the district, as in the case of the ordinary consumer.

From 1914, the volume of gas consumed is a record taken from the copies of account supplied by the audit department. The price charged for gas used for power on the works is the net cost into the holder; and the total cost of gas consumed is calculated on this basis.

The high cost of the last 65,400 c.ft. of gas used is due to the fact that we were gas-making for only five months of the financial year, and as the total net expenditure incurred during the twelve months is divided by the gas produced, it naturally follows that the cost into the holder is high.

The average net cost of gas into the holder during the period under review was 15·24d. per 1000 c.ft. The volume of gas consumed was 5,078,900 c.ft. The weight of material dealt with was 111,651 tons. Therefore the amount of gas consumed per ton of material dealt with is equal to 45·48 c.ft. per ton. The total cost of gas used by the large engine for breaking and elevating coal into bunkers, and elevating coke for the producers and retorts, is 0·693d. per ton.

TABLE No. VI.—*Extractor Gear.*

	£	s.	d.
Total materials, including new loose pulleys, five top halves of worms, &c.	110	8	9
Labour during the period	28	6	4
Stauffer boxes	1	8	0
Stauffer grease	21	3	8
	£161	6	9

Coke extracted, 63,755 tons; cost, 0·607d. per ton of coke.
Coal carbonized, 99,297 tons; cost 0·39d. per ton of coal.

It has already been mentioned that an error of judgment when letting-down No. 2 setting for the first time, and the lack of thought on the part of the workmen when dismantling No. 1, were responsible for the cost of renewing the top halves of five of the extractor worms. In addition, we have had two new loose pulleys; and two sets of brasses for the main-drive shaft, one pawl for main drive, 12 small pawls for retort drive, a few springs, safety bolts, &c., make up the total sum expended for material. As you are all aware, the machinery, with the exception of the first shaft on the main drive, is slow running; and, if it is kept well fatted, the cost of maintenance should be low. The labour includes taking down extractors, straightening worm shafts, fitters' and labourers' time on new pulleys and brasses, fixing new worms, and general attention to extractor gear. Calculated on the coal carbonized, the cost is 0·39d. per ton.

Having on more than one occasion been asked for my experience regarding the condition of the extractor worms after they have been working for some time, I have taken the opportunity to include a photograph (fig 2) of a worm top which had been in use from the erection of the plant in 1910 till it was dismantled in 1921. As you will notice, the worm is worn thin, but is still good for several years' work.

At the present time there are in operation four of the original worm tops supplied with the plant. We have not yet had occasion to renew any bottom halves; the originals being still in use. On the same illustration you will see the only worm shaft which has worn thin and broken. The point of thinning is where the shaft enters the coke chamber through the bearing which is part of same. All shafts are now protected by threading on a piece of wrought-iron pipe before fixing the worm. The same result could be obtained by lengthening the bearing, and thereby preventing the coke from abrading the shaft as it rotates.

Owing to corrosion and resultant thinning, we had to renew several of the tripods which support the shaft a little higher up. The steam enters (in the plant at Droylsden) just where one limb of the tripod rests in the pocket cast on the coke chamber to receive it. I would suggest to the makers of the plant that if the position of the steam supply were altered so that the steam did not impinge directly on the arm, this corrosion would be prevented.

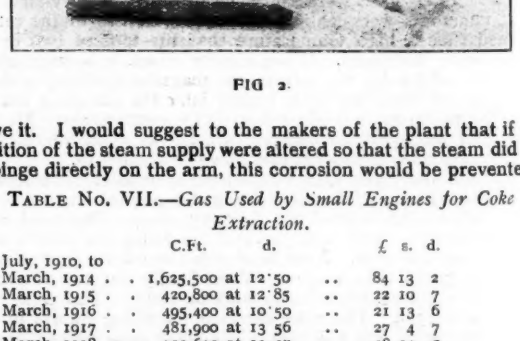


FIG 2.

TABLE No. VII.—*Gas Used by Small Engines for Coke Extraction.*

	C.Ft.		d.		£	s.	d.
July, 1910, to March, 1914	1,625,500	at	12·50	..	84	13	2
March, 1915	420,800	at	12·85	..	22	10	7
March, 1916	495,400	at	10·50	..	21	13	6
March, 1917	481,900	at	13 56	..	27	4	7
March, 1918	523,600	at	13 27	..	28	19	0
March, 1919	570,000	at	15·08	..	35	16	4
March, 1920	524,800	at	17·97	..	39	5	10
March, 1921	547,800	at	26·31	..	60	1	6
May, 1921	101,000	at	37·83	..	15	18	5
	5,290,800				£336	2	11 = 15·25d. per 1000 c.ft.

Cost calculated on coke extracted = 1·265d. per ton of coke extracted.

Cost Calculated on Coal Carbonized.

Coal carbonized	99,297 tons
Gas consumed	5,290,800 c.ft.
	= 53·28 c.ft. per ton

at 15·25d. per thousand = ·812d. per ton of coal.

Table No. VII. required very little explanation. The cost for gas is shown on the weight of coke extracted, as well as on the tonnage carbonized. Which is the more correct method is open to discussion, though for purposes of comparison there is little doubt that the cost based on the coal carbonized is the more accurate. Why? Because the quantity of coke extracted is a variable, and is dependent in a large measure upon the method of working the plant.

TABLE No. VIII.—*Coke Elevator—Cost of Material and Labour.*

	£	s.	d.
Total material used, including new chain, rollers, slippers, patch plates for boot, &c.	104	17	4
Feb., 1917—Wages of fitter erecting chain	14	15	10
Sept., 1920—Wages of fitter on new pins, slipper, rollers, &c.	22	5	5
Labour at the works during the period under review	24	17	7
Stauffer grease	4	10	9
Total cost	£171	7	3

Coke elevated for the producers	11,668 tons
Coke elevated for filling retorts	704 ,,
	12,372 tons

Total cost—3·324d. per ton of coke elevated.
0·414d. per ton of coal carbonized.

TABLE No. VIII.—COKE ELEVATOR.

I look upon this as the most costly of the mechanical portions of the plant, not because we have expended an excessive amount for repair and renewals, but because the machine stands doing nothing but rust for 21 out of every 24 hours; and as it is fully exposed to the weather, this does not tend to improve its condition. Coke is elevated for producers during the night shift—viz., 10.0 p.m., 12.0, 2.0, and 4.0 a.m. In addition, it is run twice per week for about half-an-hour while we elevate coke for filling retorts after scurfing. For greasing the links, &c., it is run on Monday afternoon for about 15 minutes.

You will notice that no oil is charged against the elevator, and this requires some explanation. Waste oil is collected from the engines and mixed with cylinder oil discharged with the exhaust from the various machines (provision being made for collecting this). The mixture is cleansed from grit by being filtered through a cloth; and the resultant thick and highly-efficient lubricant is poured from an oil kettle on to the links, &c., while running for the purpose.

It is pleasing to note that the contractors have seen the error of their ways; and the capital expenditure on a piece of apparatus which stands doing nothing for most of its time has been eliminated. In later installations, one conveyor deals with both coal and coke. We learn as we live.

The total cost during the period has been:

3·324d. per ton of coke elevated,
or ·414d. ,, ,, coal carbonized.

TABLE No. IX.—*Bench Ironwork.*

	£	s.	d.
Cost of material used, including 16 mouthpieces, and complete set of cast-iron sight boxes to replace the fireclay plugs originally used	150	9	0
Wages paid during the period	37	13	0
	£188	2	0

Coal carbonized = 99,297 tons = 0·455d. per ton carbonized.

TABLE No. IX.—BENCH IRONWORK.

The table showing cost of bench ironwork is one which those of you who have verticals would hardly expect to see, as this should be an almost negligible item in the cost of maintenance of verticals. Droylsden, as an experimental station, has incurred a greater expenditure in this direction than most works of the same size.

You will notice that the cost of material is shown as £150. The greater part of this is covered by the provision of a complete set of new mouthpieces—not renewed because they were worn out, but, owing to the introduction of a later type, installed for the purpose of observing their behaviour. In addition we have replaced the original fireclay plugs with cast-iron sight boxes.

Apart from these two items, the cost of material for renewals has been low. Drop plates for retorts, take-off pipe covers, ball plate, valve spindles and wheels, steam nozzles, and two special retort lids, are practically all that have been provided. Included in the labour is the cost of cleaning and greasing coal valves, and cleaning take-off pipes and valves, when the plant has been let-down for repair, and all other expenditure for general attention to the bench ironwork during the period.

The cost based on the material carbonized was 0·455d. per ton.

TABLE No. X.—*Total Cost of Maintenance of Retorts and Producers.*

	£	s.	d.
Original cost of retorts, floor tiles, linings of settings and producers	980	0	0
Rebuilding No. 2 setting	453	0	0
Rebuilding No. 1 setting	543	0	0
Fireclay goods	81	1	5
Podge, mainly used for making joints of ball plates and cover on coke chamber	7	3	7
Producer ironwork, including furnace bars, spear bars, lintel and rest bars, also a new step grate complete with the necessary fittings at a cost of £39 3s. 8d.	148	5	2
Labour during the period	476	16	5
	£2689	6	7

Coal carbonized = 99,297 tons = 6·500d. per ton.

Table No. X. is the one no doubt you have all been looking forward to, because it is on maintenance and repairs of retorts and producers that the largest item of expenditure is incurred. I will not anticipate discussion, but feel that the method adopted for obtaining the costs will not meet with the approval of some of the members. It may be open to criticism.

The first item in the table represents the original cost of the retorts, floor tiles, and lining, and the lining, &c., in producers. The second and third are the contract prices paid for the renewal of both settings. If you deduct these three items from the total, you have a residue of £713. Of this, £148 represents the cost of producer ironwork—a figure which appears to me to be very high. It certainly came as a surprise that the sum expended on furnace and spear bars was no less than £93—an item of expenditure which, with the step grates at present installed, is almost entirely eliminated.

In the notes on Tables I. and II. you observe that we have not had occasion to do much patching of the retorts; ramming of the cracks with podge (a mixture of fireclay with silica ground into a stiff plastic mass), and washing with suitable material, being all that was required.

When it has been necessary to insert a patch, so far, we have used for this purpose some inclined retorts which we had left over from the old installation. Thanks to their shape, we have been able to cut a piece of suitable radius to suit the patch required. To hold these patches in position from the back side, we have, after cutting a small ledge on the patch, used two end-splay bricks set with their angles together. Resting the square end of one of the bricks on the floor tile and the other square end upon the ledge cut in the patch, we have obtained a good support without undue restriction of the passage for the products of combustion.

The wages for labour were £477; and a fairly large proportion of this would be expended upon the producers, which always required considerable attention, and renewal of linings.

The original producers were of the bar-grate type, with closed doors and the usual provision for admission of primary air. The grate area of these was about 0·6 sq.ft. per ton of coal carbonized per day. This grate area is, I believe, common to a variety of retort installations, and appears to me to be too small. Restricted grate area must of necessity (if you are to maintain good temperatures) lead to hard firing, with resultant production of large clinker and considerable erosion of the producer lining.

Digressing for a moment, I may state that in the reconstructed settings we have installed large producers. One of them has a grate area of 1·4 sq.ft. per ton of coal carbonized per diem, and the other 0·85 sq.ft. These large producers have given entire satisfaction; the fuel being burned to ashes without the production of clinker. The producers are of the open step-grate type.

Included in the labour charges is all time spent by the bricklayer and his mate in the retort-house. Should the weather be unsuitable for outside work, the time is occupied pointing and washing the outside walls of the setting, and clearing the dampers of dust. The settings are therefore maintained in a high state of efficiency; but the cost of maintenance is slightly increased. Daily attention to the dampers (half to one hour per day) is charged against carbonization, but all other work is included in the cost stated.

Based on the coal carbonized, the total cost of maintenance of retorts and producers is 6·500d. per ton. Whether this figure compares favourably or otherwise with any other system of carbonization I do not know, as I have refrained from looking up the literature on the subject.

Comparative costs with other types of plant will no doubt be brought forward by those members who are interested; but my purpose has been to place before you what I believe to be a true and accurate record of the cost of maintenance and repair of the installation at Droylsden.

TABLE No. XI.—*Retort-House Governor.*

	£	s.	d.
Material and repairs to bell and float, and new bell and float	13	8	3
Labour during the period	11	8	10
Total	£24	17	1

Cost, based on coal carbonized = 0·06d. per ton.

Almost from the commencement, the retort-house governor was a source of irritation. I use this word because, though the cost has been low, regular attention to the apparatus was necessary to prevent trouble with stoppage at the valve or outlet pipe. The introduction of liquor supply assisted matters somewhat, but in the first place the type of governor installed was not suitable for the work. A governor which gives excellent results with horizontals may be a source of trouble with verticals. Owing to the high temperature of the gas and to the fact that the collecting mains are of the wet-dry type, there is a tendency to deposit salts at the first point of friction, and this is usually the retort-house governor. (See "JOURNAL OF GAS LIGHTING," Vol. CXIV., p. 903.) With certain materials we had no trouble, but with others the foreman had to spend a little time each shift taking out the plug on the outlet and clearing with a short rod—only a few minutes' work, and (as I have said) more irritating than troublesome.

The labour cost represents the time occupied by the handyman for overhauling, cleaning, and general attention to the apparatus;

the attention given by the foreman being charged against carbonization. The cost is ·06d. per ton.

TABLE No. XII.

	£	s.	d.		
Inspection	15	4	6	= ·0366d.	per ton.
Greasing	155	11	9	= ·3760	,,
Stokers' mitts	14	14	0	= ·0355	,,
Timber for charging stage	18	4	7	= ·0440	,,
	£203	14	10	= ·4921	,,

On Table XII. there are four items. These are placed together because it did not appear necessary to introduce a separate table for each item. They are inspection, greasing, stokers' mitts, and timber. From 1911 to 1916, it was the practice to send from the Bradford Road works a fitter who inspected and kept in good working order all the machinery at Droylsden; and a proportion of the cost of this service has been, for the purpose of this communication, debited to the retort-house. The machinery in the retort-house is greased twice weekly—viz., on Tuesday and Friday—and the time occupied is not more than nine hours per week, which, over the period, represents, for wages, £155 11s. 9d. It is advisable to provide the stokers with mitts; and the expenditure for these has been £14 14s.

The timber purchased was to replace those portions of the charging stage which from time to time were destroyed—generally during the burning-out of the take-off pipes. The cost was £18 4s. 7d. The handyman fixed the new timber as required; and the small item of expenditure under this head is included in retort-house ironwork wages.

Summary of Tables.

	Cost per Ton of Coal Carbonized. d.
Maintenance and repair of gas-engines	·390
Maintenance and repair of coal elevator	·461
Gas used for coal breaking, elevating, &c.	·693
Maintenance and repair of extractor gear	·390
Gas used for coke extraction	·812
Maintenance and repair of coke elevator	·414
,, ,, bench ironwork	·455
,, ,, retorts and producers	6·500
,, ,, retort-house governor	·060
Inspection, greasing, stokers' mitts, and timber	·492
	10·667d.

As the average yield of gas during the whole period was 13,240 c.ft. per ton, on the basis of the gas produced, the cost is equal to ·805d. per 1000.

This completes the story so far as costs are concerned; but I have been requested to include three other tables which no doubt will be of interest to you. They are—

Results obtained during the period under review, and for one full year after reconstruction.
Quantity of fuel used on the producers.
Quantity of breeze produced.

These tables require practically no explanation. The first two are extracted from a series compiled by the statistician and issued by the Gas Committee. The third represents the quantity of coke and breeze sold at the works (not sold and used) for which we have received cash, and is therefore a statement of fact. In this connection I may mention that during the reconstruction we installed in the old inclined retort-house a large boiler fitted with a Wilton furnace, in which we consume the whole of the breeze produced, so that at present we have none for sale.

Statistical statements, however interesting to those immediately concerned, are generally very dry reading. Therefore the notes and comments are introduced with a desire to render the communication more easy of assimilation, and in the hope that they may be of some interest to those members who have not yet had any experience of this type of plant.

Coal Carbonized and Gas Produced, &c.

—	Coal Used.	Gas Made.	C.Ft. per Ton.	Calorific Value B.Th.U.	Therms per Ton.	Net Cost into Holder per 1000 C.Ft.	Net Cost into Holder per Therm.
						Pence.	Pence.
July 14, 1910 to Mar. 31, 1911	8,435	94,795	11,238	..	..	..	..
Mar. 31, 1912	10,466	133,508	12,756	542	69·13	11·94	2·203
Mar. 31, 1913	9,179	120,383	13,115	546	71·60	12·41	2·273
Mar. 31, 1914	9,820	126,987	12,932	553	71·51	12·14	2·200
Mar. 31, 1915	8,283	98,214	11,849	545	64·57	12·85	2·382
Mar. 31, 1916	9,462	109,539	11,577	537	62·16	10·50	1·955
Mar. 31, 1917	8,390	105,582	12,465	517	64·44	13·56	2·623
Mar. 31, 1918	9,423	129,743	13,769	512	70·49	13·27	2·591
Mar. 31, 1919	8,583	127,925	14,904	479	71·39	15·08	3·148
Mar. 31, 1920	8,603	132,154	15,350	457	69·14	17·97	3·993
Mar. 31, 1921 to May 10, 1921	383	5,994	15,650	447	69·95	..	..
	99,297	1,314,764	13,240	..	..	..	..
	Results obtained after reconstruction.						
Apl. 1, 1922 to Mar. 31, 1923	9,891	166,791	16,863	473	79·76	19·25	4·07

Coke Used on Producers.

—	Coal Carbonized.	Coke Used.	—
			P.Ct.
July 14, 1910, to Mar. 31, 1911	8,435	1,064	12·64
Mar. 31, 1912	10,466	1,305	12·47
,, ,, 1913	9,179	1,047	11·41
,, ,, 1914	9,820	1,156	11·77
,, ,, 1915	8,283	889	10·73
,, ,, 1616	9,462	1,004	10·61
,, ,, 1917	8,390	924	11·01
,, ,, 1918	9,423	1,082	11·48
,, ,, 1919	8,583	948	11·05
,, ,, 1920	8,603	984	11·43
,, ,, 1921	8,258	1,206	14·60
Apl. 1, 1921, to May 10, 1921	383	59	15·40
	99,297	11,668	11·75

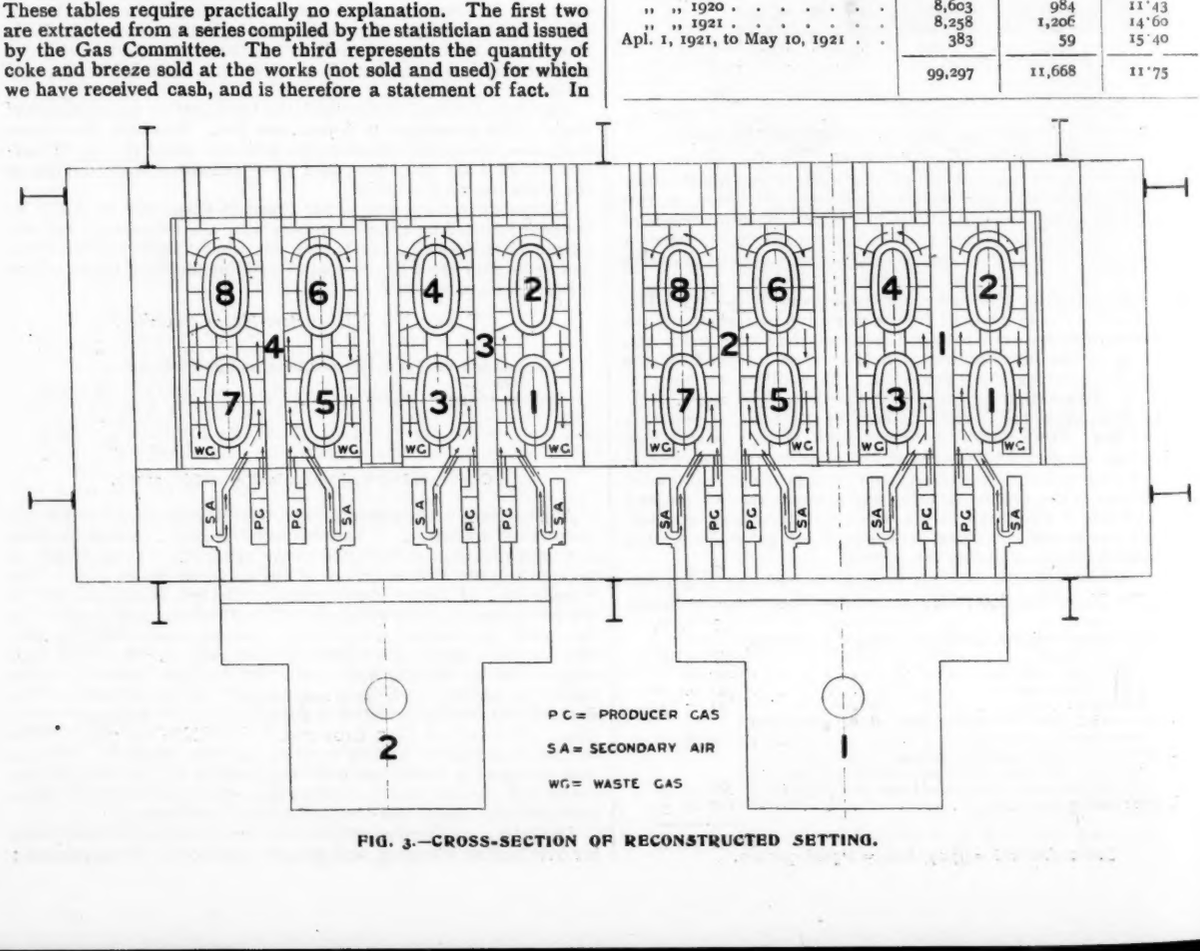


FIG. 3.—CROSS-SECTION OF RECONSTRUCTED SETTING.

Table showing the Quantity of Breeze produced by the Vertical Retorts at Drcylsden.

Year Ending.	Coke and Breeze Sold.	Breeze Sold.	Breeze.	Stocks.	
				Coke.	Breeze.
	Tons.	Tons.	P.Ct.	Tons.	Tons.
March 31, 1911 .	..	..	.. .	..	180
,, 31, 1912 .	5,029	637	12·66	None	None
,, 31, 1913 .	4,224	368	8·71	10	66
,, 31, 1914 .	4,664	352	7·55	120	160
,, 31, 1915 .	4,669	759	16·98	None	4
,, 31, 1916 .	4,655	477	10·24	None	30
,, 31, 1917 .	3,921	450	11·47	20	70
,, 31, 1918 .	4,386	564	12·86	60	240
,, 31, 1919 .	3,980	609	15·30	None	275
,, 31, 1920 .	3,840	794	20 68	None	None
..	39,168	5,010	Average 12·80 p.ct.	..	..

Discussion.

Mr. F. H. ROBINSON (Harrogate) submitted a comparison between the results recorded by Mr. Buckley of retort working at Droylsden with two beds of retorts of the Glover-West type, and those of four beds of Woodall-Duckham retorts at Harrogate. According to Mr. Buckley, the life of the retorts in No. 1 bed was 1593 days, and in No. 2 bed 1544. At Harrogate the working days, since resetting in 1916, were as follows: No. 1 bed, 2220 days, up to May 8, 1923; No. 2 bed, 2399 days; No. 3 bed, 2150 days; and No. 4 bed, 2100 days. In the Droylsden case, 27,000 tons of coal were used per bed during the life of the retorts, against 32,000 tons in the Harrogate case. It should be remembered that gas used for coal breaking and elevating, and for coke handling, depended on the design of the plant, and whether the settings were arranged in one line or in two parallel lines. At Harrogate they were arranged in the latter formation, with cross-band conveyor. Further comparisons were as follows:

DROYLSDEN.	HARROGATE.
Elevating coke, 4 times in night.	Once a day.
Grate area—	
(1) 1·4 sq. ft. per ton.	1·13 sq. ft. per ton nominal capacity
(2) 0·86 ,, ,, ,,	1·6 ,, ,, ,, actual ,,

As regards effective area, Mr. Robinson remarked that angle bars gave less effective area than step grates for the same size of producer. Chimney pull was a controlling factor. At Harrogate, work was carried on with open doors, and the gas to the settings was controlled by tiles. The greatest wear on retorts, he had found, was near the bottom, and was due to the erosion of hard coke. As a comparison of costs, he would give the following figures: Droylsden verticals, from July, 1910, to May, 1921—gas for coal and coke handling, ·693d. per ton; gas for coke extraction, ·812d.; repairs and maintenance, 9·162d.; total, 10·667d. per ton. At Harrogate, 1915 to 1922 inclusive—Verticals: ·672, ·472, 10·030d. per ton; total, 11·174d. per ton. Horizontals: Repairs and maintenance only, 13·73d. per ton. The coal carbonized at Harrogate was 127,562 tons with the verticals, and 115,737 tons with the horizontals. Again, Harrogate repairs included repairs to all plant connected with the verticals inside the retort-house. Horizontal repairs included re-setting retorts twice, regenerators once for the whole house, and also the re-building of pier walls and arches for one half. Vertical repairs were carried out before high prices came on. The horizontal repairs were carried out during higher prices—about 150 p.ct. above those of 1915. A correction was therefore made in the horizontal costs to prices ruling in 1915 and 1916, in order to make a truer comparison with the repairs to verticals. Mr. Robinson complimented Mr. Buckley on the detailed work he had put into his paper. It was not often one could get costs worked-out in such detail.

Mr. W. B. M'LUSKY (Halifax) said the remarkably low costs set forth in the paper bore evidence of careful and efficient maintenance. The best thing in the paper was the good all-round results. The next best thing was the form in which these results were presented. The whole composition was a readable account of good work well done; and the reason of it all was Mr. Buckley himself. The tables were a model; and they constituted in themselves a valuable contribution to the transactions of the Institution. "It is a relief," Mr. M'Lusky proceeded, "to know that the highest yield of gas claimed per ton of coal carbonized is only 16,863 c.ft. It is a comfort to find a modest figure like this associated with such excellent results. The resolving figure, 79·76 therms per ton of coal carbonized, is quite 11 p.ct. better than the best results recorded for the best type of horizontal setting. Dealing more particularly with maintenance costs, one can only compliment the author on the exceedingly low expenditure under this head, namely, 10·667d. per ton—or 0·805d. per 1000 c.ft. of gas, based on the average yield of 13,240 c.ft. per ton for the ten years under review. The vertical retorts at Halifax have been at work only two years, and the expenditure to date only consists of maintenance and running costs which, though not so low as those quoted for the latter years of Mr. Buckley's history, compare quite favourably. For example, the combined cost of breaking, elevating, conveying, and depositing coal in the overhead storage bunkers, and removing, elevating, and depositing coke in the overhead bunkers is 0·46d. for power, compared with 0·886d. for a different type of plant used for a similar purpose at the inclined retort-house, which was installed twenty-four years ago, and which is still responsible for quite half the total production of gas. The additional tables furnished by Mr. Buckley are most interesting and informative. They show that the production of gas from the vertical stack for the year 1912 was 133,508,000 c.ft., 12,756 c.ft. per ton, 69·13 therms, with a coke consumption of only 12·47 p.ct., compared with 129,940,000 c.ft. for the year ended March 31, 1921, when the yield per ton was 15,735 c.ft., the thermal value per ton 70·80, and the fuel consumption 14·60 p.ct. For the year ended March 31, 1923 (results obtained after reconstruction) the total production was 166,791,000 c.ft., the yield 16,863, and the thermal value 79·76 therms, which, it will be observed, is equal to 18,000 c.ft. of 444 gas, or 20,000 c.ft. of 400 gas—80 therms in each case. It will be interesting to compare the net value of the gaseous product in therms, less the cost of fuel, taking both at fixed prices, for the purpose of comparing one with another.

	s.	d.
1913 results:		
71·61 therms at 6d.	35	9·6
Fuel consumption, 2·27 cwts. of coal at 1s. 6d.	3	4·7
Net value	39	2·3
	6·57d.	
1921 results:	s.	d.
69·95 therms, at 6d.	34	11·6
3·08 cwts. of coal at 1s. 6d.	4	7·5
Net value	39	7·1
	6·79d.	
1916 results:	s.	d.
62 therms, at 6d.	31	0
2·2 cwts. of coal, at 1s. 6d.	3	2·2
Net value	34	2·2
	6·61d.	

These figures are, of course, influenced very largely by the gas-making value of the coal and the residual value of the coke. The variation in this respect has been considerable during the period covered by the paper. The figures at least show that any statement of energy produced per ton of coal, apart from the value of coke consumed and available for sale, is not complete. The figures further prove, I think, that Mr. Buckley has not strained the yield per ton or the yield in therms at the expense of coke consumed in the furnaces, and has obtained his results without putting any undue strain on the plant. The cost of repairs and renewals proves this. The figures in this section and the alteration in the grate area are interesting. I have been devoted to large grate areas for over twenty years. The vertical settings at Halifax have a grate area of 22·5 super. ft. for the production of fuel gas for the carbonization of 20 tons of coal per setting. The new type of furnace in the Halifax inclined settings has a grate area of 37·9 super. ft. for the production of fuel gas for the carbonization of 27 tons of coal per diem—three old beds of sixes. This area equals 1·4 super. ft. per ton of coal carbonized. The grate area for the vertical settings is 1·125 super. ft. per ton of coal carbonized. The fuel consumption in Halifax is higher than that quoted by Mr. Buckley—being 14·56 per 100 lbs. of coal carbonized; but the waste-heat boiler recovers a percentage of the fuel expended—viz., the equivalent of 6 cwt. of good fuel per hour, which is equal to 3 lbs. per 14·56 lbs. of fuel used. Our experience of retort renewals in Halifax has been confined to horizontal and inclined settings. Over the five years ended March 31, 1917, the cost of all repairs and renewals of retort settings was 10·27d. per ton. For the five years ended March 31, 1922, the figure was 15·87d.; but, of course, labour and materials cost more in the latter period. In conclusion, may I be allowed to offer my congratulations to Mr. Buckley for a paper which will be useful not only to those who have vertical retorts, but to all interested in the economical utilization of coal. The thanks of the Institution are due to Mr. Buckley for a contribution that will be most valuable for reference. It will not only be a lasting support to those who are striving to obtain the results, but it will supply a satisfactory answer to every extravagant claim.

Fuel Expenditure per Therm—Statement Submitted by Mr. W. B. M'Lusky in the Discussion on Mr. Buckley's Paper.

TABLE "A."—The Cost of Production per Therm is Extracted from the Paper. Coke Consumed in the Producers is Valued at the Prices Current at the Different Dates.

TABLE "B."—Same Results Compared at Fixed Rates for Gas and Coke.

Year.	Therms Produced per Ton of Coal.	Cost of Coal per Therm.	Apparent Cost of Coal per Ton.	Cost of Coke Used in Producers.			Total Cost of Coal and Coke.	Coal and Coke per Therm Produced.	Gas Valued at 6d. per Therm. Coke Valued at 1s. 6d. per Cwt.
				Cwts. of Coke Used per Ton of Coal Carbonized.	Price of Coke per Cwt.	Cost of Coke per Ton of Coal Carbonized.			Apparent Cost per Therm for Coal and Coke.
			s. d.		s. d.	s. d.	s. d.	d.	d.
1913 .	71·6	2·273	13 7·7	2·27	0 7	1 3·9	14 11·6	2·51	6·57
1916 .	62·0	1·955	10 1·2	2 12	0 9	1 7·1	11 8·3	2 26	6 61
1921	69·95	5·847	34 0·8	3·08	2 3	6 11·2	41 0	7·04	6·79

N.B.—The above statement suggests that 10 therms at (say) 6d. per therm is equivalent to 4 cwt. of coke at 1s. 3d. per cwt.

Mr. A. L. JENNINGS (Cleckheaton) said that, having had charge of a continuous vertical plant for nine years, he was much interested in the paper. He would like to know whether the materials with which the settings were renewed were the same in both cases.

Mr. BUCKLEY answered in the affirmative.

Mr. JENNINGS went on to say that his experience was that the life of a setting was much shortened every time it was let down—certainly to the extent of a hundred days. Apparently, letting down a setting would have some effect on the life of it; but this was not altogether borne out by the life of the settings after the repairs. No. 1 setting worked 1247 days, and was let down three times; No. 2 worked a longer period—namely, 1544 days, and was let down four times. From all the figures, it would appear that there was some other factor

involved, such as material, because in some cases the results were not the same. No doubt the life of vertical retorts was very much affected by their being let down. His own view was that each time a setting was let down its life was shortened by certainly a hundred days. It would appear that this view was somewhat endorsed by the difference in the life of No. 1 and No. 2 installations after the repairs, as No. 1 setting worked 1593 days and was let down twice only; while No. 2 installation worked 874 days, and was let down four times. This view was not altogether endorsed, however, for after the re-setting the installation which worked the longer was let down more frequently than the installation which had the shorter life. Hence his desire to know if the materials were the same in both of these resets.

The President again expressed his regret that there was not time for a fuller discussion, and left it with the meeting to say whether the further consideration of the paper should be deferred to the next meeting.

Mr. Carr (Stretford) pleaded for an adjournment of the discussion so as to give members an opportunity in the meantime of considering the details of the paper, and comparing them with the results of their own experience. He moved that the discussion be adjourned.

This was seconded, and met with unanimous approval.

Mr. Buckley thereupon made only a brief reference to the points raised by the speakers. He agreed with Mr. Jennings that the life of a setting was shortened by being let down.

On the motion of Mr. Bloor (York), seconded by Mr. Hudson (Normanton), the hearty thanks of the meeting were accorded to Mr. Buckley for his paper.

Mr. Buckley, in reply, said the task of preparing his paper had been a labour of love—he would not do it for money. He had spent many hours in his researches—in the evenings, on Saturday afternoons, and on Sundays.

Coke for Blast Furnaces.

In a paper prepared for the recent meeting of the Iron and Steel Institute, Messrs. E. R. Sutcliffe and E. C. Evans say that the latest statement of the essentials of a good blast-furnace coke is that of Mr. Reese; and the following summary of his requirements can probably be taken as representing modern British views on the subject: (1) Freedom from ash and sulphur. (2) High carbon content. (3) Resistance to the action of CO_2 in the upper region of the furnace. (4) Rapidity of combustion. To secure this, the size of the coke lumps must not be too great. (5) Uniformity of size—a maximum size of 4 in. to 6 in.; and, on the other hand, freedom from smalls. (6) Strength without "density," as density is inimical to rapid combustion and fast driving. (7) Porosity—or highly developed cellular structure—which, however, must not be so open as to reduce strength, with the consequent production of smalls. (8) Hardness to resist abrasion in the furnace. While some of the qualities asked for are above criticism, in so far as the third requirement is concerned—resistance of the coke to solubility in carbon dioxide—the authors venture to propound the heresy that this quality, far from being detrimental, is actually one of the most valuable that a coke can possess. The objections to a weak coke are well known, but if a coke is strong enough to withstand the burden, and to resist excessive abrasion during its passage through the furnace, this is all that is required; and if by the sacrifice of a proportion of these qualities a higher degree of combustibility can be gained, it will be to advantage in securing greater fuel economy in the furnace. The authors have found that the combustibility of a carbonized fuel is primarily dependent not so much on the percentage of volatile matter it contains, as upon its structure. Provided care be taken to obtain a certain characteristic structure in the resulting product, a coal can be carbonized at practically any temperature, in practically any type of carbonizing system, and still retain an extremely high degree of combustibility. The factors involved in the production of this structure are suitable preparation of the coal prior to carbonization, and carbonization of the coal as slowly as possible consistent with economic requirements. By suitable methods of treatment, a fuel can be obtained of hardness equal to that of metallurgical coke, of density approaching that of coal, and with a combustibility or "reactivity" of the order of that of charcoal. Reference is made to the work of Sir George Beilby; and the paper has an addendum by Prof. R. V. Wheeler on the reactivity of coke.

Deterioration of Stonework.—The question of the deterioration of stonework in buildings is a matter of general economic importance. But in the cases of our historic buildings and ancient monuments, prevention of the serious decay and gradual demolition of tooled surfaces and main structures constitutes a special problem which has engaged the attention of many investigators for a considerable time, without, however, bringing any generally satisfactory solution. The investigation involved is complex, and needs to be approached from different angles with the help of wide scientific knowledge. Accordingly, it has been decided to set up, under the Department of Scientific and Industrial Research, a special Committee of the Building Research Board, to report on the best methods by which decay in building stones, specially in ancient structures, may be prevented or arrested. The Chairman of the Committee will be Sir Aston Webb, K.C.V.O., P.R.A.; and the other members will be: Mr. R. J. Allison, C.B.E., F.R.I.B.A., Prof. C. H. Desch, F.R.S., Mr. A. W. Heasman, O.B.E., Mr. J. A. Howe, O.B.E., Sir Herbert Jackson, K.B.E., F.R.S., Dr. Alexander Scott, F.R.S., and Mr. H. O. Weller, M.Inst.C.E., Hon. A.R.I.B.A. All communications should be addressed to the Secretary, Department of Scientific and Industrial Research, Old Queen Street.

FURTHER DEVELOPMENTS AND APPLICATIONS OF THE TULLY PLANT.

A visit to the works of the Bedford Gas Company was greatly appreciated last Friday, when a gathering composed of gas engineers and pressmen was shown the working of the most up-to-date Tully plant; the future scope of the process being indicated.

The visitors, among whom may be mentioned Lord Waring, Sir Harry Brittain, M.P., Messrs. R. G. Shadbolt (Birmingham), G. M. Gill (London), H. C. Smith (Engineer and General Manager of the Tottenham and District Light, Heat, and Power Company), Walter Chaney (London), Samuel Cutler, jun. (London), J. B. Hansford (Engineer and Manager of the Bedford Gas Company), George Evetts (London), E. J. Hutchence (Gas Light and Coke Company), H. Hollings (South Metropolitan Gas Company), and representatives of about eighteen London and Provincial papers, numbered about eighty, and were met at the station and conveyed to the Bedford Gas-Works in motors. Having assembled at the works they were sectionalized and conducted round the plant under the able guidance of Mr. C. B. Tully and two of his sons who are connected with the firm of Tully Gas Plants, Ltd.

Impressions of the Plant.

The installation comprises two sets, each capable of producing 750,000 c.ft. of gas per 24 hours. On first viewing the plant, one was immediately impressed by the excellent engineering features of the entire structure, a general impression which a more careful scrutiny served only to strengthen. Mention was made that Messrs. Samuel Cutler & Co. had done the constructional work of the plant; and the results of their thoroughness are everywhere evident, the workmanship being of high quality. Though fundamentally the plant does not differ from those erected in recent years, many refinements have been effected in design, and additional aids to efficient working have been made. Among these may be mentioned an automatic stoker which eliminates much waste and considerably shortens the time taken for recharging, and a device which facilitates clinkering.

An Outline of the Working.

The Tully gas passes from the scrubber outlet direct to the relief-holder main, and from there is pulled into the foul main from the retort-house. The mixed gases are then pulled through a water-tube condenser, and pass from the exhauster through the usual washing and purification plant to the holders. The mixed gas is metered in the ordinary way, and a continuous record of the calorific value is obtained by means of a water-flow recording calorimeter. The coal carbonized in the retort-house is weighed on its way to the crusher, and the fuel gasified in the Tully plant is measured by means of a tared charging hopper. Carbonizing results are estimated daily, the method of calculation being as follows.

Results at Bedford.

The coal gas make is assumed as 11,500 c.ft. per ton; the quality being 580 B.Th.U. per c.ft. From the data available, the mixed gas make and the coal gas make are obtainable. The Tully results are then calculated by difference.

	C.Ft.	B.Th.U.	Therms per Ton.	C.Ft.
Mixed gas make	751,000	463	87·00	18,780
Coal ,, ,,	368,000	580	66·70	11,500
Tully ,, ,,	383,000	580	175·50	50,000
Tully plant	34,800 c.ft. per hour		11 hours worked	
	4,350 c.ft. per run		88 runs	
Dilution	51 p.ct. (on mixed gas)		Clinkered once	
Fuel used in Tully plant (half coal, half coke)			7 tons 12 cwts.	
Fuel ,, retort-house			32 tons	

Steam pressure at generator, 35 lbs. Cycle, 2 min. blow, 5 min. run. 4 up runs, 1 down run. Blast pressure .. primary 19 in. secondary 9½ in.

Mixed gas per ton of coal used for the month of March, 18,977 c.ft. at 460 B.Th.U. .. 87·30 therms.

The number of hours per 24 hours that the Tully generator was working averaged about 12.

Average analysis of Tully gas:

CO_2	4·5 p.ct.	Calculated calorific value, 362 B.Th.U.
O_2	0·2 ,,	Actual tested, 346 B.Th.U.
C_nH_m	0·2 ,,	Calculated in results as 357 B.Th.U.
CO	37·0 ,,	Sulphur compounds, 17 grains per 100 c.ft.
CH_4	7·3 ,,	Naphthalene, slight trace.
H_2	45 0 ,,	Cyanogen, slight trace.
N_2	5·8 ,,	Sp. gr., 0·550.
	100·0	

Manufacturing costs:

	Pence per 1000 C.Ft.
Fuel at 34s. per ton	7·90
Blast (gas-engine driven)	0·28
Steam	1·00
Operating and clinkering (maintenance and sundries)	0·82
	10·00
= 2·74d. per therm.	
Capital charge	0·24d. per 1000 c.ft.
	0·08d. per therm.

The above results have been prepared by Mr. J. B. Hansford (Engineer and Manager of the Bedford Gas Company). The year the plant was put into operation, the Company carbonized 24,000 tons of coal; and this year the quantity will be approxi-

mately 15,000 tons, with an increase of about 7 p.ct. in gas sold—a saving of 9000 tons. The operating of the plant is done by one man per shift (with a little help on the morning shift for clinkering) or three men per day; the daily make of each unit being 750,000 c.ft.

The plant installed at Bedford is certainly a model one, from blower house to recording calorimeter, and reflects great credit on the Engineer and Manager.

The History of the Tully Plant.

After the inspection, Mr. C. B. Tully outlined the history of the Tully plant. It is an interesting story of achievement; but space does not permit of any detailed account. The latest plants are adapted to many varied processes. If it is desired to obtain a rich gas, a carburetter is fitted, from which, it is maintained, efficient results are obtained. A revolving grate not only provides a solution to the troubles of clinkering, but also, Mr. Tully affirmed, results in a 30 p.ct. increase in output, and allows of the utilization of a wider range of fuels. A joint producer and Tully-gas plant has been specially designed for a plate-glass factory in Switzerland; and the accounts of its working are both encouraging and satisfactory. An order has been placed from Italy for five units, each of a capacity of 750,000 c.ft. per day and fitted with waste-heat boilers and carburetters.

The Tully Low-Temperature Process.

Another recent development is the "Tully Low-Temperature Process." The plant for this consists of twin generators working in conjunction with a bed of vertical retorts. Part of the Tully gas made is used for heating the retorts, and the remainder serves as a diluent for the rich low-temperature gas. Mr. Tully maintains that, by the union of the two processes, a sound economic commercial undertaking has been entered upon, which will produce a rich gas of constant thermal value, a fuel suitable for domestic requirements which will serve to reduce the destruction and waste caused by the burning of raw fuel, and fuel oils, including motor spirit and lubricating oils, in sufficient quantity for all home requirements. By this combined process, said Mr. Tully, at least 80 p.ct. of the thermal efficiency of the coal carbonized is obtained in the shape of smokeless fuel and the other products named.

The Catalytic Processes.

Reference was then made to the new catalytic processes of which we have heard so much during the past few weeks. It was a little difficult to arrive at a clear conception of these; but from what we can gather there are two distinct aims—one for the production of hydrogen to be used either for the manufacture of synthetic ammonia or for the inflation of dirigibles, the other for the conversion of the carbon monoxide and carbon dioxide to methane.

The Manufacture of Hydrogen.

For the manufacture of hydrogen, the Tully gas, after passing through the scrubbers and purifying plant, is led through a converter before being metered and passed to the gasholder. The desideratum is to convert as much carbon monoxide as possible into the easily removed carbon dioxide; and it would appear that the gas led into the converter is mixed with excess steam and passed over a catalyst, which we may presume to be of either an iron or a nickel base. This conversion is based on the reversible reaction known as the water-gas equilibrium:

$$CO + H_2O \rightleftharpoons CO_2 + H_2 + 10{,}200 \text{ calories.}$$

This reaction occurs at a temperature of about 550° C.; and the function of the catalyst is to speed up the reaction velocity, which is normally very low at such a temperature. The resulting carbon dioxide is washed or absorbed out of the gas.

The Conversion of Carbon Monoxide and Carbon Dioxide into Methane.

The second process—the conversion of carbon monoxide and carbon dioxide into methane—is based on the following two reactions:

$$(1)\quad CO + 3H_2 = CH_4 + H_2O + 50{,}800 \text{ calories}$$
$$(2)\quad CO_2 + 4H_2 = CH_4 + 2H_2O.$$

Carbon monoxide reacts readily with hydrogen in the presence of finely divided nickel, particularly at temperatures between 250° and 300° C., according to equation (1). It is patent from the exothermic nature of the reaction that methane will be favoured by low temperature, and, from volume considerations, by high pressures. The reaction, however, goes very completely at ordinary pressure if excess hydrogen be used. Carbon dioxide is converted into methane by passage over reduced nickel at 350° C. in like manner to carbon monoxide, as in equation (2). According to the information supplied by Mr. Tully, a given town gas consisting of a mixture of coal gas and Tully gas had a composition as follows: CO 22·8 p.ct., H_2 44·7 p.ct., CO_2 5·4 p.ct., CH_4 17·1 p.ct., C_nH_m 3·0 p.ct., N_2 6·1 p.ct., and O_2 0·6 p.ct. The gas, on passing over the catalyst, has practically the whole of the CO converted, in the presence of steam, into CO_2 and H_2. The gas now has the composition of 0·8 p.ct. CO, 57·2 p.ct. H_2, 24·0 p.ct. CO_2, 13·1 p.ct. CH_4, no oxygen, and 2·9 p.ct. N_2. This gas, owing to the high CO_2 content, is subjected to a washing process; and after the elimination of this inert constituent, Mr. Tully's figures for the final gas are: H_2 75·3 p.ct., CH_4 17·2 p.ct., C_nH_m 2·6 p.ct., CO 1·3 p.ct., N_2 3·6 p.ct. The foregoing processes are very interesting, but are by no means new; nor is their application on a commercial scale novel.

Luncheon.

The party were then conveyed to the Swan Hotel, where a luncheon was given at the invitation of Messrs. Tully Gas Plants, Ltd.

After the Loyal Toast,

Sir Harry Brittain, M.P., in a spontaneous and outspoken speech said that, as one who appreciated the value of the work which Mr. Tully had done, not only for the gas industry, but for the nation as a whole, he congratulated the Directors of the Bedford Gas Company on their courage and enterprise. They had been the first to instal the Tully plant, and they must feel proud of their foresight in a realization of the successful results which had been the outcome of their wise action. The processes which Mr. Tully had invented were forging ahead, and the present success was due to the untiring and persistent efforts of Mr. Tully, to whom, as an inventor, the word "pioneer" had ceased to be a hazy vision, but was fraught with meaning. The life of a pioneer, wherever he might be, was one of hardship, and this was particularly so in England. The lack of backing which fell to the lot of a British inventor was one of the distressing features of the old country. The new combination of gasification plant would mean a great deal to the basic life of the country; and in this the Press could afford much help.

The Rev. Wyllie (Chairman of the Bedford Gas Company) said that a risk was always attendant on any pioneering work; and the Board had certain apprehensions when they decided to instal the first Tully plant at their works. Time had proved, however, that no grounds existed for any misgivings, and the excellent working results of the plant had proved an ample reward for what was then a bold policy. He was proud of the Press, with which his late father had long been connected, but he regretted that they had dealt with the gas industry in a manner which fell far short of justice, and had erred equally in an exaggeration of the benefits said to be derived from the use of electricity. He made a plea for common fairness in dealing with such questions, and felt sure that the time had already arrived when gas could be acknowledged as the friend of the poor.

Mr. C. B. Tully said it gave him great pleasure to enjoy the company of those present. The gathering commemorated the satisfactory completion of a new and forward step in the scientific gasification of coal. They were assisting at the birth of another idea in the science of complete gasification, and were offering the younger generation fresh knowledge which they might use in their progress towards perfection. He had been accused of being an optimist; but had he not been such, he would never have successfully encountered the numerous difficulties with which he had had to contend. His whole life had been spent in an endeavour to serve the gas industry. Looking back on his career, he had to say that the old conservative industry was not all that could be desired. His remarks might offend or please, but he was of the opinion that the gas industry was of secondary importance to the great field they had for the development of gas for industrial purposes. They, Messrs. Tully Gas Plants, had inquiries for industrial work from all quarters of the world, and they were at present putting up some very large installations. In all cases, their inquiries were for 350 B.Th.U. gas. If the gas industry did not take the hint, they would lose all their large consumers. The important future of his business lay in the development of the production of gas for industry. During the past few years, many propositions had been put up for gas of varying composition, such as: Gas rich in hydrogen, gas free from methane and hydrocarbons, gas low in hydrogen. These propositions had launched them into the development of physical chemistry and a study of the reactions and phenomena of gases. The result was that they were able to produce gases of practically any composition within reason. The reduction of carbon monoxide in gas of any kind was the first and most simple catalytic reaction they had dealt with. Carbon monoxide in the presence of steam, at temperatures between 400° and 600° C., is converted into carbon dioxide and hydrogen. One volume of hydrogen is obtained for every volume of carbon monoxide converted into carbon dioxide. The latter could be removed by absorption by water, diffusion, or compression and liquefaction—or partially by these and finally by lime. The cost of the removal, or rather the substitution of hydrogen, depended upon the cost of the removal of carbon dioxide and the heat required to support the catalytic reaction taking place. This would probably be under one penny per 1000 c.ft. The gas industry, continued Mr. Tully, was familiar with the catalytic treatment of gas in the heat purification process of Dr. Carpenter and Mr. Evans. Practically the same plant was necessary for the removal of carbon monoxide; and he hoped to have the benefit of Dr. Carpenter's experience in this direction. Having solved the proposition of obtaining a gas with an excess of hydrogen, the next step was to convert this excess with carbon monoxide to produce methane. He would also mention another important development. This was the combination of the Tully plant with the low-temperature process. The idea was to heat the setting by means of Tully gas, which would also serve as a diluent. The advantages of the system were many. In the first place, the capital construction cost and wear and tear were less. There was no stoking or clinkering, and the heats were under constant and absolute control. The plant would produce low-temperature fuel or ordinary gas coke at will. He was convinced that they were making an important step forward. The preservation of national resources, the utilization of wealth, and the elimination of wealth leakage were essential.

Capt. P. Sandford said that when Mr. Tully first showed him his proposals over four years ago, he was at once fascinated by the idea of gasifying coal by a single operation in one vessel. In the past, coal had been so plentiful and cheap that very few people in this country had paid any attention to conserving what had been the bedrock of national greatness. He did not think that there was the slightest likelihood of this occurring in the future owing to the necessity for meeting foreign competition and in so doing keeping the costs of production down to the absolute minimum. The function of the engineer, and specially the gas engineer, was to make the country more comfortable for everyone. In his opinion, the consumption of gas was only a frac-

tion of what it should be. He believed in the application of gas for heating and cheering their homes and cooking their food. Mr. Tully was looked upon as a worker in the gas industry. This was doubtless due to his extraordinary pluck and untiring energy. The elimination of carbon monoxide from household gas was likely to have far-reaching results, and would undoubtedly increase its popularity; particularly as the process appeared to be simple and cheap. With reference to the plant installed at the Bedford works, he would like to congratulate the Bedford Gas Company, and in particular their Engineer, Mr. Hansford, on putting-down the first unit of its size in the world. The Tully plant had other important spheres, as well as the gas industry, such as the distillation of shale, the production of hydrogen for the manufacture of sulphate of ammonia, and other purposes.

Colonel F. A. Wilson, D.S.O., proposed, and Lord Waring seconded, the health of Mr. Tully.

THE ELIMINATION OF CARBON MONOXIDE, AND ITS EFFECT ON THE GAS INDUSTRY.

By C. B. Tully.

The satisfactory completion of the Tully complete-gasification plant at Bedford is the starting point for further development of the greatest importance to the gas industry.

The Bedford plant has a capacity at full load of two million c.ft. of gas per day; and the next step will be the building of plants of treble this capacity, fitted with revolving self-clinkering apparatus. Negotiations are in hand for several large installations for gasification of low-class coal and cannel at the pit head, for the recovery of the bye-products, for obtaining rich gas for town lighting and larger volumes of low-grade gas for the generation of electricity by means of internal-combustion engines, for the heating of kilns, and for other purposes. This development brings up the gigantic proposition of linking-up the gas and electricity industries of the country under one roof—an amalgamation having much to commend it on the score of economic administration and national economy.

The presence of carbon monoxide in large quantities in water gas, and to a lesser extent in Tully gas, has been detrimental to its more general application. The reduction of this objectionable constituent to any desired limit offers a field of untold possibilities. The South Metropolitan Gas Company alone have applied the knowledge of catalytic gas reactions to the manufacture of town gas. For many years they have been treating the whole of their gas for the removal of the sulphur compounds by means of the Carpenter-Evans process.

The removal of carbon monoxide can be effected in practically the same type of plant. When Dr. Carpenter started his process, he had not the advantage we have to-day in the choice of metals for the construction of plant, nor had he the benefit of the work of the metallurgists done during the war in the discovery or manufacture of metals which will stand up to the most drastic requirements. There is no novelty in the catalytic treatment of gas; it is for the gas engineer to apply this knowledge.

The reduction of carbon monoxide depends upon the reversible reaction known as the water-gas equilibrium.

$$CO + H_2O = CO_2 + H_2O + 10{,}200 \text{ calories.}$$

This reaction is what is commonly known in water-gas practice as the secondary reaction, resulting as it does in an excess of CO_2. Tully gas plants have been designed with this object in view, and of producing a gas sufficiently high in hydrogen without the use of a separate converter plant.

The next and perhaps the most important step from the gas industry's point of view is the conversion of carbon monoxide into methane.

$$CO + 3H_2 = CH_4 + H_2O + 50{,}800 \text{ calories.}$$

The reaction can only be obtained with a gas having hydrogen in excess. The catalyst used for the conversion of carbon monoxide in the Newark plant is the production of Dr. Jaques, of Liverpool, and Mr. J. H. West, of London. It has proved exceedingly active and cheap, and operates best at about 600° C. If it continues to stand up to the sulphur impurities of crude hot gas, free from dust and tarry matters, as it has done so far, many important economic adaptations await it. In the case of town gas it is proposed to treat purified gas for the removal of CO on its way to the holder. There are other catalysts active at very much lower temperatures, which can be used on purified gas; and although more expensive in the first case, these will probably prove cheaper in the end.

Early in the war, the writer worked with Dr. Maxted on this proposition; and a patent was taken out for a modified Tully plant for the production of a gas rich in hydrogen. For the want of finance this invention was not proceeded with—which was just as well, because the success of the process first depended upon the satisfactory working of the complete-gasification plant. Now that this objective has been attained, and capital is at command, further work will be done in this direction.

The carbon monoxide reduction in town gas is a thing of the greatest simplicity, and can be adapted to gas-works of any capacity. Tully gas or water gas, as the case may be, can be used for heating the converter. Controlled by a thermostatic valve, the plant will require very little attention. The question has been raised as to the removal of the carbon dioxide produced in the process. There are many ways of effecting this, depending upon local conditions—in any case it is not a serious matter.

Several gas engineers have already offered to take up the process and help in its development. This was only to be expected of such gentlemen, knowing as they do the struggles of the past against ignorance and inaccurate statements circulated by competitors all over the world. However, these have all been lived down; and with strong financial backing behind the Tully plant, development will be rapid and of vast importance not only to the gas industry but to industry generally.

The year 1923 is going to see great developments in the gasification and utilization of coal. It is a job for the gas engineer as well as for the theorist.

An American Rotary Displacement Meter.

In a paper which he read before the Wisconsin Utilities Association, Mr. Erwin C. Brenner described the design and operation of a Connersville rotary displacement meter having a capacity of 20 million c.ft. of gas per day. This meter is installed at the works of the Milwaukee Gas Company, and records all coke-oven gas purchased by the Company. In general design and construction, the meter is very similar to that of ordinary blowers and exhausters. Since, however, the meter is not doing work, but is being driven by the pressure of the gas metered, it is possible to increase considerably the displacement of the impellers per revolution. This is accomplished by reducing the thickness of the impellers at the waist. Besides increasing the displacement, two further desirable factors are introduced. The first is an increased area of contact between the impellers, and between the impellers and the case. This materially reduces the slip, and hence increases the accuracy of the machine. The other is an increase in impeller area acted upon by the inlet gas pressure—making it possible to drive the meter at a low differential. To reduce mechanical friction to a minimum, and permit a low operating differential, the impeller shafts are mounted on ball-bearings packed in grease. At each end of the case is a pair of timing gears operating in oil. Their function is to keep the impellers in the same relative position. The counter is connected with the impeller shafts through a 10 to 1 reduction gearing. To obtain the actual revolutions, the reading of the counter must be multiplied by 10. At the opposite end of the case a hand-wheel is located, to be used in making slip tests. The inlet connection is at the top of the meter, making the direction of rotation of the impellers downward at the sides of the case. This renders the meter self-cleaning, and reduces the possibility of damage from particles carried in suspension in the gas. The method of calibrating the meter is explained. In a twenty-one days' comparative test, the difference between the rotary displacement meter and a Thomas meter was 668,000 c.ft., or 0·207 p.ct. of the gas metered; with a Pitot tube, the difference was 340,000 c.ft., or 1·02 p.ct. of the gas metered.

Southern Association Visit to Plymouth.—The programme has now been issued by the Hon. Secretary (Mr. W. H. Bennett) of the forthcoming visit of the Southern Association of Gas Engineers and Managers to Plymouth, by invitation of the Chairman and Directors of the Gas Company. On Thursday, June 7, a meeting of the Western District Section will be held in the Royal Hotel, at 3.30, to which members of the Eastern District are cordially invited. Those attending will be entertained at tea upon arrival by the President (Mr. Percy S. Hoyte) and Mrs. Hoyte. On Friday morning, June 8, motor coaches will leave the Royal Hotel at 10 o'clock, to convey members to the gas-works, an inspection of which will be made under the guidance of the President and his staff. (The works will also be open on the following day, in case any members should wish to pay a second visit.) After luncheon at the Royal Hotel, as the guests of the Chairman and Directors of the Plymouth and Stonehouse Gas Light and Coke Company, there will be a motor and steam-boat trip to Totnes and Dartmouth, kindly arranged by the Directors of the Company, who have extended their invitation to the luncheon and excursion to ladies accompanying members.

"B.C.G.A." Southern District Conference.—The present series of District Conferences of the British Commercial Gas Association will be closed by a meeting in the Town Hall, Bournemouth, on Monday, June 11, under the presidency of Mr. William Cash, F.C.A., the Chairman of the Bournemouth Gas and Water Company. At the morning session there is to be a paper by Mr. P. G. G. Moon (the General Manager of the Bournemouth Gas and Water Company) on "Sales and Service;" and the afternoon public conference will include a lecture by Dr. C. W. Saleeby entitled "Light and Life." It is hoped that members who are attending the Plymouth meeting of the Southern Association will make a special effort to be present at the Bournemouth meeting also.

An Interesting Volume from France.—We have received a copy of the well-bound and elaborately-indexed annual volume of the Syndicat Professionnel de l'Industrie du Gaz, in which are collected for reference all the circulars issued during the year 1922. In these the members are kept regularly informed of much that is interesting to gas men. Legal, parliamentary, technical, and general information concerning the gas and electricity industries is sent to members in "tabloid" form, with references to the sources from which those who wish can obtain fuller accounts.

SURFACE COMBUSTION, WITH SPECIAL REFERENCE TO RECENT DEVELOPMENTS IN RADIOPHRAGM HEATING.

[A Paper by William A. Bone, D.Sc., Ph.D., F.R.S., Professor of Chemical Technology at the Imperial College of Science and Technology.]

At a full Meeting of the Royal Society of Arts, last Wednesday evening, a paper was read by Dr. W. A. Bone on the above subject.

OPENING REMARKS BY THE CHAIRMAN.

Mr. D. MILNE WATSON (the Governor of the Gas Light and Coke Company) occupied the chair, and, in introducing Prof. Bone, said: It is not necessary to introduce Prof. Bone to you, as I am sure he is well-known to you all. Not only has he stood on many previous occasions before audiences in this room, but his important position at the Imperial College of Science and Technology at South Kensington, and his work on the Fuel Economy Committee of the British Association, keeps him prominently before all those interested in science or the conservation of coal. Prof. Bone has been engaged in the study of fuel problems from his early days, and has for many years now been guiding the thoughts of young engineers and chemists towards methods for the more economical use of fuel, so as to reduce waste and prolong the period during which our most valuable national asset will remain available. In the course of this work, he appears to have become specially attracted by the action of an incandescent surface on mixtures of gases, with the result that he has given to this subject many years of painstaking study. Surface combustion is thus a subject which Prof. Bone has made specially his own, and is one with which his name will be for ever associated.

Previous to his work, it was known that a hot surface had the power of increasing the rate of combination of gases below their ignition point; but Prof. Bone showed that surfaces at temperatures above the ignition point did so to a still greater degree, and with increasing effect with increasing temperatures, such as are obtained by an intimate mixture of gas and air in explosive quantitives. By the development of this process, he has been successful in converting a large proportion of the potential energy of gas when burned immediately into radiant form, and further in continuing the production of surface combustion into a bed consisting of granular refractory material. Great advantage was obtained from this latter process in the gaseous firing of multitubular boilers. By introducing this system of combustion in the tubes of the boiler, efficiency was largely improved, greater evaporation per square foot of heating surface was obtained, and more steam produced per cubic foot of gas used, while no brick setting or expensive foundation was necessary. The size of the boiler is, of course, comparatively small. An increase in efficiency of gaseous firing, by whatever means it is brought about, and whatever direction it takes, is extremely important to-day, as it must increase the tendency to a reduction in the use of solid fuel, and prove another step in smoke abatement—in which direction Prof. Bone's work has proved very helpful.

His study of surface combustion, and the great number of interesting experiments he has made, have no doubt done much to elucidate several of the problems connected with it; and they have interested a very great many in the process. Both in America and Germany great interest has been shown in the proposals, and experiments have been instituted and plant installed for their adoption. The fact that in surface combustion we have apparently flameless combustion—for although the flame is not visible, I believe it is there—and also that we have radiant heat in a form from which it is very easily and conveniently transferred, is one that makes it very attractive for many purposes; and further developments may be safely expected. Some time ago Prof. Bone indicated that there were many points in the mechanism of surface combustion still to explain, and that many years would be required to realize the wide range of industrial possibilities for which it is suitable; and from the apparatus before me, I should not be surprised if we are to learn a little to-night of some of these further applications.

INTRODUCTION.

When I had the honour, nine years ago, of delivering in this place a series of Howard Lectures on "Surface Combustion," I related both the history of the subject and my own researches, culminating in the discovery, about the year 1909, of the phenomenon termed by me "flameless incandescent surface combustion," as conditioned by the catalyzing powers of incandescent refractory solids generally. This phenomenon was demonstrated and exemplified in the then new processes of "diaphragm" and "incandescent bed" heating respectively, which had been experimentally developed by me in conjunction with the late Cyril Douglas McCourt. I am here to-night for the two-fold purpose of re-affirming what I then said concerning incandescent surface combustion as being for many purposes the most economical and advantageous method of developing and applying radiant energy by gaseous combustion that science has yet discovered, and of describing and demonstrating some recent developments in the manufacture of "radiophragm" appliances, which, it is anticipated, will soon lead to a rapid extension of the system in both the domestic and the industrial fields.

THE PRINCIPLE OF INCANDESCENT SURFACE COMBUSTION, AND SOME HISTORICAL OBSERVATIONS THEREON.

Seeing that so many years have elapsed since my last public lectures on the subject—years during which progress has been hindered by the great war, by the much-lamented death on a Flanders battlefield of my gifted collaborator, McCourt, and by other circumstances that need not be detailed—it is perhaps desirable that, first of all, I should recall how the principle of flameless incandescent surface combustion was conceived as a definite phenomenon distinguishable from ordinary flame combustion, and afterwards realized and applied by McCourt and myself in our well-known system. Indeed, it seems necessary at the outset to clear the air by reference to the historical aspects of the subject, because attempts have been made to obscure and misrepresent incontrovertible facts with regard to the origin and interpretation of surface combustion, so that its basic principles are in danger of being lost sight of. Therefore, without further apology, I will endeavour briefly to re-state what these principles are, and how they were discovered.*

Undoubtedly the starting-point was Sir Humphrey Davy's well-known experiment (1817), in which he tried the effect of introducing a warm platinum wire into a jar containing a mixture of coal gas and air rendered non-explosive by an excess of the combustible constituents. The wire immediately became red hot, and continued to glow until nearly the whole of the oxygen had disappeared.† But though Davy was the first to observe an instance of surface combustion, he was far from recognizing that all incandescent surfaces are equally capable of effecting it. On the contrary, he believed that a metal surface (and preferably one of platinum) was necessary. Moreover, he never seems to have conceived of an intensification of flame combustion by such means.

During the period of 1820-35, a number of distinguished chemists (Dulong and Thénard, Döbereiner, William Henry, Thomas Graham, Faraday, and de la Rive) experimented on the power possessed by solid surfaces generally of inducing the slow combination of combustible air-gas (or gas-oxygen) mixtures at temperatures below their ignition points. No experiments were, however, made during this period on the far greater powers possessed by incandescent surfaces; the observations being confined to the inducing of slow combustion at much lower temperatures. The close of the period was marked by a celebrated controversy between Faraday and de la Rive (1834-5) as to the mechanism of such slow surface combustion. De la Rive regarded it as involving a series of rapidly alternating oxidations and reduction of the surface; while Faraday contended that the function of the surface is to condense both the oxygen and the combustible gas, thus producing in the surface layers a condition comparable with that of high pressure.

It may be wondered why, after so auspicious a start, all interest in the subject evaporated after 1835, and was not revived for half-a-century. The researches of Deville on the dissociation of steam and carbon dioxide, in which incandescent surfaces had been employed, had begotten the wholly mistaken notion that, because such surfaces promote dissociation, they must necessarily also hinder combustion. The late Frederick Siemens undoubtedly upheld this view, for he contended that in furnace design and construction the contact of burning gases with hot surfaces should be avoided, because (as he thought) such surfaces "interfere with the rapid motions of the gases necessary for combustion; and in the second place, they cause dissociation . . . and by doing so, of course, a vast amount of heat is lost." Moreover, he said, "complete combustion is impossible whenever live or active flame is allowed to come into contact with any solid surface." Unfortunately for progress, the effect of Siemens' teaching on contemporary thought was to obscure the real issue. For while it is undoubtedly true that a cold surface thrust into a flame may cool the combining gases in its vicinity below their ignition temperature, and so hinder combustion, yet an incandescent surface will always accelerate gaseous combustion, as the late Thomas Fletcher, of Warrington, rightly maintained. It may be recalled that in the year 1887 this pioneer of modern gas-heating appliances demonstrated to an audience in this room the possibility of realizing a flameless surface combustion by directing a mixture of gas and air on to a large ball of incandescent iron wire; but, unfortunately, he does not seem to have followed the matter beyond this point. Towards the end of last century, renewed interest in the influence of hot surfaces on gaseous combustion was manifested among chemists, chiefly as the result of certain persistent attempts of the late Victor Meyer and others to determine the ignition temperatures of explosive mixtures by a particular method, which were thwarted by irregularities in the results, caused by the then unsuspected large action of the hot walls of the containing vessels.

It was in the year 1902 that, in conjunction with Dr. R. V. Wheeler (now Professor of Fuel Technology at Sheffield Uni-

* For a fuller statement of the historical aspects of the subject the reader is referred to the "Howard Lectures" delivered by the author in 1914 ("Jour. Roy. Soc. Arts," Vol. LXII., pp. 787-92).

† Davy's "Researches on Flame."

versity), I began systematically to investigate as a fundamental problem the accelerating influence of hot surfaces on combustion.* And as the subsequent technical developments have been based upon principles discovered or elucidated during a series of scientific researches carried out under my direction by a succession of skilled collaborators† during the past twenty years, I think it right to draw attention to what I consider the more important features of the work.

By the year 1907, I had succeeded in proving (1) that at temperatures below the ignition point all hot surfaces have the power of accelerating gaseous combustion in varying degrees, according to their chemical character and physical texture; (2) that whenever a mixture of combustible gas and oxygen (or air) is combining in contact with such a hot surface, the chemical action mainly occurs in, and is usually confined to, the boundary layers between the gaseous and solid phases, wherever these may be in contact; (3) that not only does the accelerating influence of a hot surface upon combustion rapidly increase with the temperature, but also that the differences between the powers of various surfaces, which at low temperatures are often considerable, diminish with ascending temperatures until at bright incandescence they practically disappear; and (4) that all such surface combustion, whether at high or low temperatures, depends upon an absorption of the combustible gas, and probably also of the oxygen, by the surface, whereby it (or they) becomes "activated" by association with the surface.‡

Such considerations led me soon afterwards (1907) to conclude that, if an explosive gaseous mixture be either injected on to, or forced through the interstices of, a porous refractory incandescent solid under suitable conditions, a greatly accelerated combustion would take place within the boundary layers between the gaseous and solid phases, wherever these might be in contact; and that the heat developed by such intensified combustion would maintain the surface in a state of incandescence without any development of flame, thus realizing the idea of *a flameless incandescent surface combustion*. Unfortunately, certain circumstances connected with my duties at Leeds University precluded for a while my developing this idea further. But when, in October, 1909, I was able to resume its pursuit, the late C. D. McCourt became my collaborator; and our subsequent technical researches (1909-12) were carried out in association with Messrs. Wilsons and Mathiesons, Ltd., at whose works in Leeds our experimental station was located. The problem which McCourt and I then set out to solve was defined by me in October, 1909, in the following terms:

> To bring a combustible mixture of gas and air in suitable proportions into contact with the interstices of an incandescent porous solid of suitable composition and porosity in such a manner as to produce a flameless, or as nearly as may be flameless, surface or interstitial combustion whereby the porous solid shall be maintained in a continual state of incandescence.

The resulting system of incandescent surface combustion which we conjointly worked-out and demonstrated during the years 1909 to 1912, inclusive, comprised principally two processes, in both of which a homogeneous explosive mixture of gas and air in the proper proportions for complete combustion (or with air in slight excess thereof) was caused to burn catalytically without flame in contact with a granular incandescent solid, whereby a large proportion of the potential energy of the gas was immediately liberated in a radiant form. And all subsequent developments, whether in this country or abroad, have embodied our original principle without essential change. Constructional modifications adapted to particular circumstances and conditions may have been made from time to time—*e.g.*, variations in the precise way in which the explosive mixture is brought into contact with the incandescent surfaces, or alterations in the form of injectors—but these have not involved any change in the underlying principle of the combustion process itself.

Perhaps I may be allowed at this point to re-state, and draw attention to, the advantages claimed for our system of incandescent surface combustion over the older practice of flame combustion. First of all, the combustion is accelerated and intensified by the incandescent surface, and can be concentrated just where the radiant heat is required. Secondly, the combustion is perfect, with the minimum excess of air. Thirdly, the attainment of very high temperatures is possible without the aid of regenerative devices. And, further, owing to the large proportion of radiant energy developed, transmission of heat from the seat of combustion to the object to be heated is very rapid and efficient. I may perhaps be excused some feeling of enthusiasm for my child; but I trust it is so tempered by my scientific outlook that it does not warp my judgment. I will venture to reaffirm my belief that a perfect and intensified combustion is so combined in our system with a high radiant efficiency and rapid heat transmission that, when rightly understood and intelligently applied under proper auspices and direction, it is bound in the end to win its way and to become for many (if not most) purposes, the premier one.

It is no part of the purpose of this paper to recount all the numerous applications of "surface combustion" which McCourt and I introduced before our more active connection with the enterprise ceased when the war broke out. They are recorded in the lectures which I gave on the subject during the years 1911 to 1914, inclusive, before some of the leading scientific and technical institutions in this country, America, and Germany.* For the moment it will suffice for me to recall that, in addition to the experimental demonstrations of the principle of surface combustion and its manifold applications, which were given, both in connection with the said lectures and at our experimental station, we successfully installed and put into operation (*inter alia*) some large furnaces with regenerative systems, and two large boilers fired by coke-oven gas at the Skinningrove Iron Works which were in constant commission for several years, until the installation had ultimately to be dismantled to make room for other more urgently needed war plant.

It is not, however, the past with which I wish mainly to deal in this paper, though after the lapse of so many years it is necessary to recall what had been achieved up to the outbreak of war, about which time the immediate technical directions of matters passed out of my hands. Soon afterwards, my gifted colleague, McCourt, relinquished surface combustion work for a commission in the Army, hoping that in such capacity his scientific training and knowledge of men would better serve his country and the cause of humanity. Alas, he was soon to be numbered among the deathless band who made the supreme sacrifice. He laid down his life for us while gallantly leading, as bombing officer, an attack on the German lines in France during the night of Oct. 8, 1916. *Mors janua Vitæ.* As one whose great privilege it was to enjoy his collaboration and close friendship during some years of fruitful pioneering research, I desire to pay my heartfelt tribute to his fine character, experimental skill, and devotion to the scientific ideal of truth and service. His death was, indeed, a great blow to the prospects of surface combustion, which he had done so much to advance.

Apart altogether from such an unlooked-for calamity, and the urgent claims of war work upon those of us who remained, it was perhaps hardly to be expected that the numerous minor difficulties of design and organization, which inevitably arise when a new and far-reaching principle, such as surface combustion, has to be adapted to large-scale industrial operations, were to be overcome in a day. After the first flush of success with such an invention, when unusual interest is aroused, and an embarrassingly large number of possible applications of it are thrust upon its authors from every quarter, there often follows a period during which a series of small and subordinate problems of detail, none of them very difficult, but in their cumulative effect seriously delaying, have to be patiently investigated. Indeed, in scientific invention there is rarely any "Open Sesame" to complete success, which in most cases is only finally achieved after the expenditure of much time and effort.

Small wonder, then, that progress with surface combustion in this country has been impeded by the war and other adverse circumstances. I understand that in the United States it has been successfully developed in connection with large-scale industrial furnaces by, or through, the organization which acquired the American rights shortly after my lecture in that country in the autumn of 1911. Some reference to this was made in the concluding chapter of my book on "Coal and its Scientific Uses" (1918), as well as to the results of a highly satisfactory test reported in 1916 by the United States Bureau of Standards to the Franklin Institute of Philadelphia, on the combustion conditions and high temperatures (1675° C.) attained with a surface combustion furnace for laboratory purposes. It is gratifying to know that the fire which we kindled across the Atlantic, now more than ten years ago, has continued to burn there with an increasing radiance appropriate to surface combustion.

Nor have things stood still here; for we are now in a position to announce a recent important advance in the method of making "radiophragms" for surface combustion appliances, which bids fair to put diaphragm heating into an unassailable position and greatly to extend its scope and usefulness. We owe this improvement mainly to the patient labours of Mr. F. J. Cox, M.I.Mech.E., who, in conjunction with Radiant Heating, Ltd. (the organization which originally pioneered "surface combustion" during the years 1910-12), has undertaken the further development of this branch of the enterprise. I now propose to explain its nature and significance; and at the conclusion of the paper, Mr. Cox himself will demonstrate it to you.

Recent Developments in Radiophragm Heating.

In the first of the two processes evolved by McCourt and myself in 1909—and which was termed the "diaphragm" process—a homogeneous mixture of gas and air, in the right proportions for complete combustion, was made to flow from a suitable feeding

* For this early work *vide* "Phil. Trans. Roy. Soc." (1906) A.206 pp. 1 to 7.

† Dr. H. Hartley, Messrs. G. W. Andrew, A. Forshaw, A. Robson, and others.

‡ In the year 1916 Dr. Irving Langmuir, who at the time (as he has since admitted) was unaware of my previous researches, published a theory concerning the chemical actions of surfaces (heterogeneous catalytic reactions) which included some of the ideas originally put forward by me. In a private communication to me, written after the discussion upon catalysis which took place in London on Sept. 20, 1921, under the auspices of the Faraday Society ("Trans. Far. Soc.," Vol. XVII. (1922), pp. 546-675), Langmuir acknowledged that "the general viewpoint which you had in 1906 was much ahead of others of that time, and is in many ways closely related to that which I have developed independently from a rather different experimental basis."

* "Journ. Franklin Institute," 1912; "Ber. deut. Chem. Ges.", 1913, pp. 5 to 28; "Proc. Royal Institution," and Howard Lectures on "Surface Combustion," 1914.

chamber at the back, through a porous diaphragm of refractory material, and caused to burn without flame at the surface of exit, which was thereby maintained in a state of red-hot incandescence. Such incandescent diaphragms were exhibited at my public lectures during the years 1911 to 1914 inclusive, and in some respects, perhaps, afford the most perfect and conclusive demonstration which could be devised of the reality of surface combustion as a definite phenomenon. We will presently show you such a diaphragm in operation, when you will be able to judge for yourselves of its significance and potentiality as a method of developing and applying a high degree of radiant energy by gaseous combustion.

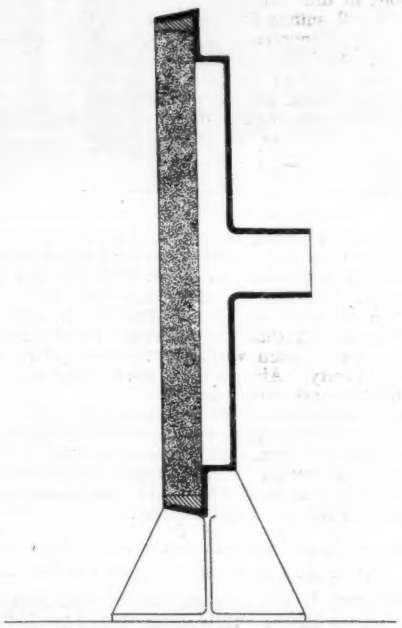


Fig. 1.

The diaphragm (fig. 1) was made of granules of firebrick bound together into a porous and coherent slab (thickness, 1½ in.) by the addition of a small proportion of a suitable cementing material, while its porosity was graded to suit the particular kind of gas used. Each diaphragm was suitably mounted on a casing; the space between the back of the casing and the diaphragm constituting a convenient feeding chamber for the gaseous mixture. When such a diaphragm was operating, the actual combustion was confined to a thin layer (⅛ in. to ¼ in. only) immediately below the surface of exit, which was thereby maintained in a state of red-hot incandescence; no heat being developed in any other part of the apparatus.

As will readily be understood, this constituted a most efficient and economical method of developing radiant heat; the combustion being both instantaneous and perfect, and the area of the radiating surface bearing a very high ratio to what may be termed the combustion depth. I recently suggested the term "radiophragm" as a suitable designation for such a "radiating diaphragm"; and by this term it will henceforth be known.

Now, though in the new radiophragm developments referred to there has been no departure in principle from the old procedure, an important advance has been made in the fabrication of the diaphragm itself, which confers very definite new advantages not realized before. And in order that you may better appreciate the significance of the change in question, I may perhaps be allowed to enlarge upon the conditions which experience has shown to be requisite for the complete and assured commercial success of radiophragm-heating. In the first place, the method of making the radiophragm should be such as will ensure not only perfect regularity of texture and porosity, but also a certain gradation of granules from back to front in relation to the quality and pressure of the gas used, so that the resultant radiation on the surface, when the appliance is in operation, shall be quite uniform. Now, by the method formerly employed, the attainment of such conditions was found in practice to be rather uncertain, and a small proportion of the resulting diaphragms had usually to be discarded, because on trial they did not altogether come up to the desired high standard of uniform radiance. Nevertheless, it produced a large proportion of good diaphragms of almost any desired area, which in operation gave a uniformly incandescent surface, and did not back-fire when run on explosive mixtures of coal gas and air, so long as the appliance was freely radiating. Indeed, radiophragms were kept running for whole days in succession at our experimental station in Leeds—the largest one having an area of 4 sq. ft.—with never a sign of back-firing when freely radiating into the room.

The chief limitation, however, of the old radiophragms lay in the fact that, if their free radiation was by any means so impeded as to allow of too great an accumulation of heat in the incandescent surface layer, which constituted the seat of the intensive catalytic combustion, the latter might in time heat-up the next granular layer to such a degree as to render it in turn capable of promoting the catalytic combustion. The latter would then leave the surface layer and commence in the one below it. It was thus possible, in circumstances of sufficiently restricted radiation, so to accumulate heat in the incandescent surface layers as to cause the seat of the intensive catalytic combustion originally set-up therein gradually to creep backwards from layer to layer in the diaphragm until pre-ignition of the mixture ultimately occurred in the feeding chamber. As a matter of fact, the actual temperature of the incandescent surface when such an appliance is radiating freely into space does not exceed 900° C.; and it was found that up to 1000° C. (but not much beyond) there was no risk of the back-firing referred to.

Notwithstanding this drawback, however, a number of the old radiophragms, selected for the purpose, were successfully employed some years ago for boiling and concentrating sugar solutions on a commercial scale in a well-known confectionery

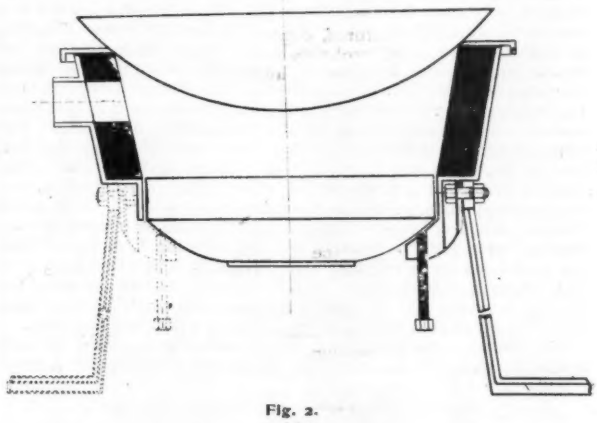


Fig. 2.

factory. The apparatus employed (fig. 2) comprised a 13-in. circular radiophragm surrounded by a brickwork setting, on which the copper pan containing the sugar solution rested. The supply of combustible gaseous mixture was controlled by one lever, which operated in a single movement the gas and air cocks; the ignition being effected automatically by means of a small pilot light. When I visited the factory in 1914, a battery of thirteen such units was in operation with good results. Each unit did ten to twelve heats lasting about twenty minutes each per diem; and some of the diaphragms had been in continuous daily use for about a year. I was told that the gas consumption (40 c.ft. per unit per hour) was not more than half what it formerly had been when the pans were heated over ordinary atmospheric flames. The secret of such economy lay in the fact that, whereas when gas flames are so used for boiling solutions in metallic vessels, the heat transmission is greatly impeded by the non-conducting layer of relatively cool gaseous products which forms between the flames and the under surface of the pan, with an incandescent radiophragm the large percentage of radiant energy so developed is instantaneously absorbed by the vessel and transferred to the liquid with high efficiency. The firm operating the battery of radiophragms in question reported them as being "very economical in the amount of gas consumed, and in every way satisfactory for our work;" and at the Bonecourt Company's offices there was exhibited a radiophragm which had been in use for the boiling of sugar solution for a period of eleven months, during which it had made 3000 boilings, each of twenty minutes' duration, with a total consumption of 100,000 c.ft. of town gas. In such cases, evidently, the absorption of the radiation by the copper vessel containing the sugar solution was sufficiently rapid to prevent any undue accumulation of heat in the outer incandescent layers of the radiophragm, so that back-firing did not occur. This may be regarded as a good example of what the old radiophragms were capable of in continuous use; otherwise their use was admittedly subject to the limitation already mentioned.

Thanks, however, to the persistent and painstaking efforts of Mr. Cox, who in recent years has devoted much time to the detailed study of the texture, grading, and manufacture generally of radiophragms, all the former limitations to their use at length have been successfully overcome, and they can now be produced in quantity by his new method with complete certainty and precision, and of such a uniform texture and gradation of granules that no back-firing ever occurs, however much the radiation from the incandescent surface may be impeded. I am not at liberty to disclose the way in which Mr. Cox makes the new radiophragms; but having seen his methods, I can testify to their thoroughness and reliability. Some of his radiophragms have been subjected to very drastic tests to prove their absolute immunity from back-firing, however much radiation is impeded, and the heat thereby accumulated in the outermost incandescent surface. In a recent test, made in America, the surface was raised to such a degree of white-hot incandescence that the surface layer began to flux without any signs of back-firing; and I have myself seen tests in which there has been a much greater accumulation of heat by

impeded radiation than the old diaphragms would have withstood without back-firing. Moreover, it is now possible to have two radiophragms operating with their incandescent surfaces opposite each other, a short distance apart, without either of them back-firing—a circumstance which was formerly impossible. I therefore think that Mr. Cox's innovations constitute such a radical advance in the manufacture of radiophragms as will make all the difference between their now comparatively limited and their ultimate extensive use in industry. And as the original inventor of the "radiophragm method" of realizing surface combustion, I gladly acknowledge that Mr. Cox seems finally to have solved, for us the problem of the apparatus, and that, in all likelihood, through his new radiophragm, my "surface combustion" process will at length come into its own.

I will presently ask Mr. Cox to start-up one of his new radiophragms, so that you may see how it operates. Specimens of the old and new radiophragms are on the table, so that you may have an opportunity afterwards of comparing them. One thing you will notice is that Mr. Cox now usually makes the radiophragms with a slightly corrugated surface, though this is not an essential feature of them. Another minor difference between the old and new radiophragms, arising chiefly from their different textures, is that the new ones take a little longer time to reach their full incandescence than did the old form; but this is quite an unimportant consideration. When they reach full incandescence, both radiophragms exhibit equally well the phenomenon of flameless surface combustion, and there is no perceptible difference. The most important difference is, as I have already stated, the fact that in Mr. Cox's new radiophragm no creeping-back of the combustion ever occurs, however much the radiation is impeded, and heat thereby accumulated in the outermost surface. As a proof that the world at large is recognizing the value of these improvements, I may say that already Radiant Heating, Ltd., have fitted-up numerous large restaurants in London and elsewhere with radiophragm installations, complete with all accessories for grilling, toasting, and cooking purposes, with such success that large repeat orders have been placed, and are being executed.

To illustrate the type of appliance which is included in such installations, I will now show on the screen a picture of a small

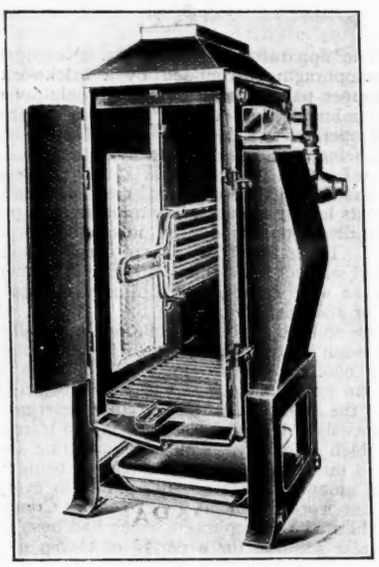


Fig. 3.

griller (fig. 3), fitted with two radiophragms, each 20 in. by 8 in., working opposite each other at a distance of 8 in. apart. The articles to be grilled (or toasted) are placed in a sliding grid midway between the two radiophragms, so that both sides of them are cooked equally and simultaneously. This arrangement of radiophragms and grid is enclosed in an oven-like casing, which also carries the feeding chambers for the radiophragms, as well as the necessary arrangements for mixing the gas and air. And, if desired, a small fan-blower, electrically driven from a wall plug, can be attached to give the requisite pressure to the combustible mixture when other means are not available. Such an appliance is capable of grilling 120 steaks or chops per hour, with a gas consumption of only 80 c.ft. The next slide (fig. 4) shows one of two batteries of four large grillers, similarly constructed, which will shortly be installed for use in connection with one of the largest restaurants in London. Each unit in the battery is fitted with four pairs of radiophragms, each of which measures 20 in. by 5 in., and four sliding grids. The supply of gaseous mixture to each pair of radiophragms is under separate control; and the whole battery of four such grillers will be capable of grilling 1000 steaks per hour.

About a fortnight ago, I had the pleasure of visiting a large public institution in the country not far from London, where 130 adult persons are housed and provided for, in which all the cooking has been done for seven months past by radiophragms

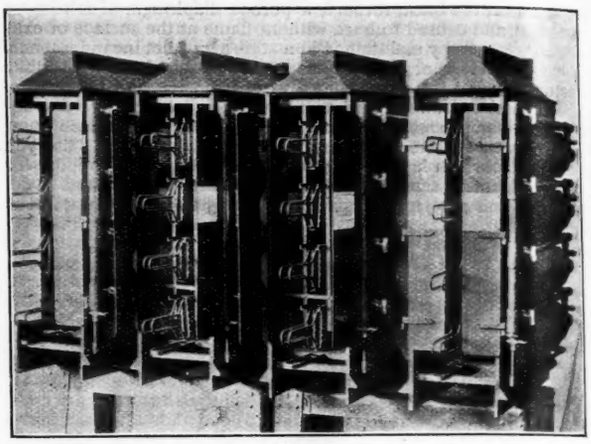


Fig. 4.

operated by petrol-air gas, to the entire satisfaction of the management. Mr. Cox has also designed for a hotel in the Midlands a jack-roasting appliance, whereby, with the aid of the new radiophragms, he hopes to bring back "the roast beef of old England" in place of the oven-cooked joints, which for many years past we have had to put up with. I feel sure that those present who are old enough to remember the quality of the roast beef produced forty years ago by a jack in front of an open fire, will wish him success in this direction.

Turning to the industrial field, some biscuit and confectionery factories have been equipped with specially designed automatic machines using gas-fired radiophragms as their sole source of heat. Appliances for lead-melting, type-founding, the hardening and tempering of metals, and for many other purposes, have been constructed and are at present on trial.

Cylindrical Radiophragms for Water-Heating, Steam-Raising, and Superheating Purposes.

So satisfactory is the new method of manufacturing radiophragms, that we have recently succeeded in producing a hollow cylindrical form which promises to be applicable to water-heating and steam-raising purposes. I may here say that McCourt and I always had in mind the possibility of making such hollow cylindrical radiophragms, but not until Mr. Cox worked-out the new method has the attempt proved successful.

There are obvious advantages to be gained by the use of such radiophragms in appliances of a tubular type for the aforesaid purposes; and though we have not as yet had time to investigate them fully, we intend doing so in the near future. Mr. Cox will presently show you a hollow cylindrical radiophragm (12 in. long and 2½ in. in diameter) fixed co-axially in a 3-in. steel tube surrounded by water in an open trough, so that you may see how it works. The mixture of gas and air, in proper proportions for complete combustion, is fed through a pipe into the hollow part of the radiophragm, and after passing through its walls is burnt flamelessly at its outer incandescent surface. The radiation thus emitted is instantly transmitted to the adjacent walls of the iron tube, through which it is conducted to the water.

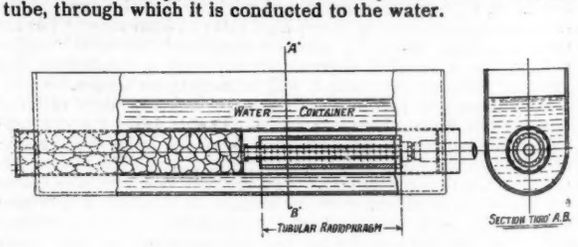


Fig. 5.

In fig. 5 is shown an experimental unit of what ultimately may be a new surface combustion water-heating or steam-raising device, consisting of a steel tube (3 ft. long by 3 in. in diameter) surrounded by water, in which are arranged (a) such a hollow cylindrical radiophragm as I have described (1 ft. long by 2½ in. diameter) on the outer incandescent surface of which the gaseous mixture is burnt without flame, and (b) a packing of granular material, or the like, about 18 in. in length. The latter serves to baffle the hot products of combustion, and to make them impinge repeatedly with high velocity against the walls of the tube (as in the original Bonecourt boiler), thus materially accelerating their cooling, and preventing or minimizing the formation of the dead film of relatively cold gases, which in ordinary boiler practice so seriously hinders the heat transmission. It would be premature to predict how such an arrangement will compare in respect of rapid heat transmission and high thermal efficiency with the original Bonecourt fundamental boiler fire-tube; but it is being tried experimentally, and on some future occasion I may be able to say more about it. It should also be possible to adapt the hollow cylindrical radiophragms fixed in such tubular appliances

for the superheating of steam in gas-fired boilers, a very important consideration.

SURFACE-COMBUSTION BOILERS.

I am loath to conclude this paper without some reference to the subject of surface combustion boilers; for though I must reserve its fuller treatment for a future occasion, it behoves me now to show how it stands, and the direction in which I look for developments. Also, some misconceptions may have arisen since last I had an opportunity of addressing an audience upon it, which perhaps my remarks may help to remove.

The seeming satisfaction of the engineering world with the poor heat transmission and thermal efficiency realized in present-day boiler design and practice is, to me, surprising. In the case of stationary land boilers of the Lancashire or water-tube type, the engineer seems content with an hourly evaporation of from 5 to 8 lbs. of water "from and at 212° Fahr." per sq. ft. of heating surface, together with a thermal efficiency rarely exceeding 75 p.ct., but too often considerably less than 70. When it is realized that such a low rate of evaporation represents a heat transmission of less than 1 p.ct. of the maximum conducting capacity of the boiler tubes, assuming an average difference of 1000° Fahr. between the mean temperature of the products of combustion passing through the tubes and that of the water surrounding them, it is at once evident how wide a margin there is for improvement.

This unsatisfactory state of affairs is principally due to the formation, on the underside of the tube, of a feebly conducting and practically stagnant film (almost one-fortieth of an inch thick) of gas at relatively low temperature which, in most of the existing types of boilers, opposes a strong resistance to the transmission of heat from the burnt gases to the water. Thus my colleague, Prof. W. E. Dalby, has calculated that of the total temperature head almost 97 p.ct. is required to overcome the resistance of the gas film, a further 2 p.ct. to overcome the resistance of a similar water film on the other side, leaving only 1 p.ct. effective as regards heat transmission across the metal of the tube.*

About the time that McCourt and I first turned our attention to the possibilities of gas-fired surface-combustion boilers, the late Prof. Nicholson, of Manchester, in following up the researches of Osborne Reynolds on heat transmission, demonstrated that the retarding influence of the gas-film may be diminished by increasing the velocity of the burnt gases through the boiler tubes or flues. But it is not yet sufficiently recognized by engineers that, inasmuch as gases are practically transparent to radiant heat, the fullest possible use should be made of radiation in boilers. For, so far as its influence on radiant energy is concerned, the "dead gas film" may be considered non-existent.

Now, in the gas-fired surface-combustion boiler invented by McCourt and myself twelve years ago, the combined advantages of the Reynolds-Nicholson principle of high gas velocities and of radiant heat were realized in (as I believe) an unparalleled manner; and in view of the inadequate appreciation there has been of the significance of the results which we obtained, I will ask your indulgence while I recall them now. Our first experiments were made with a single steel tube, 3 ft. in length and 3 in. in diameter, packed with fragments of granular refractory material meshed to a proper size, and fitted at one end with a fireclay plug, through which was bored a circular hole ¾ in. diameter for the admission of the explosive mixture of gas and air at a speed greater than that of back-firing. This tube, which may be termed the fundamental unit of our system, was fixed in an open trough containing water, like the one exhibited on the table.

Experimenting with such an arrangement, it was found possible to burn completely a mixture of 100 c.ft. of the then Leeds coal gas *plus* 550 c.ft. of air per hour, and to evaporate about 100 lbs. of water from and at 212° Fahr. per hour (20 to 22 lbs. per sq. ft. of heating surface); the products leaving the further end of the tube at practically 390° Fahr. This meant the actual transmission to the water of 88 p.ct. of the net heat developed by the combustion, and an evaporation per square foot of heating surface nearly twice that of an express locomotive boiler. The combustion of the gas was completed within 4 or 5 in. of the point where it entered the tube. Of the total evaporation, no less than 70 p.ct. occurred over the first linear foot of the tube, 22 p.ct. over the second, and only 8 p.ct. over the last foot. This pointed to a very effective radiation transmission from the incandescent granular material in the first third of the tube, where the zone of active combustion was located, though it should be remarked that the loci of actual contact between the incandescent material and the walls of the tube were so rapidly cooled by the transmission of heat to the water on the other side that they never attained a temperature even approaching red heat. The granular material in the remaining two-thirds of the tube served to baffle the hot products of combustion and to make them rapidly impinge with high velocity against the walls of the tube, thus materially accelerating their cooling, and preventing the formation of any dead gas film.

From this initial experiment we proceeded to construct our first experimental boiler, which was made of ten such tubes fixed horizontally in a cylindrical steel shell capable of withstanding a pressure of over 200 lbs. per sq. in. This boiler was connected with a small tubular feed-water heater containing 9 tubes, each 1 ft. long and 3 in. in diameter, similarly packed with granular material to facilitate the exchange of heat. With this simple combination of boiler and feed-water heater we were able, on a measured independent trial by a party of German engineers in London, to transmit to the water 93·3 p.ct. of the net heat units contained in London coal gas of 510 B.Th.U. net per c.ft. at normal temperature and pressure, and to obtain an average rate of evaporation of no less than 33·9 lbs. of water per sq. ft. of heating surface per hour (from and at 212° Fahr.). The steam-gauge pressure was 103 lbs., and the products of combustion left the feed-water heater at a temperature of 289° Fahr. I venture to think that so remarkable a result is probably unparalleled in the history of boiler trials.

SKINNINGROVE BOILER FOR COKE-OVEN GAS.

The success of this first experimental boiler enabled us to proceed immediately with the erection of a much larger plant (fig. 6)

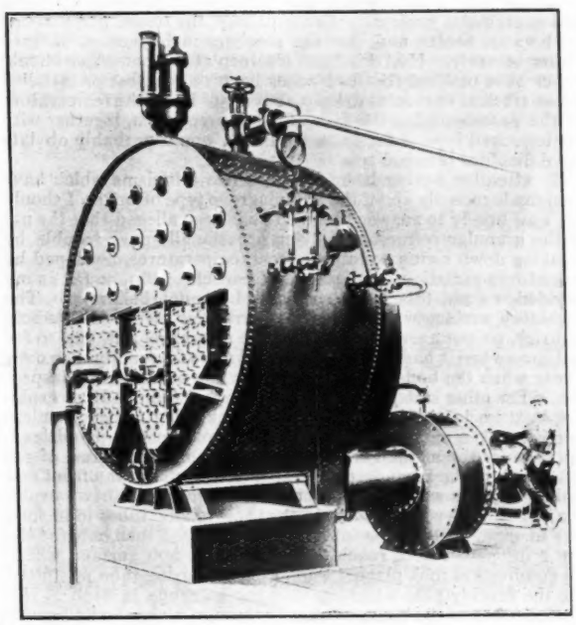


Fig. 6.

on similar lines for coke-oven gas, at the Skinningrove Iron-Works, in the year 1911. It consisted of a boiler drum 10 ft. in diameter and 4 ft. from front to back, traversed by 110 steel tubes each of 3 in. internal diameter, packed with fragments of suitable refractory granular material. To the front of the boiler was attached a specially designed gas feeding chamber which delivered washed coke-oven gas at the ordinary temperature and under a pressure of 1 to 2 in. water gauge to each of the 110 combustion tubes. This gas, together with a regulated proportion of air from the outside atmosphere, was drawn under suction from a fan, through a short mixing tube, into each of the combustion tubes, where it was burnt without flame in contact with the incandescent granular material. After leaving the boiler tubes, the products of combustion passed onwards through a semicircular chamber at the back of the boiler into a tubular feed-water heater, whence they were drawn by the fan, which discharged them at a temperature of 95° C. into the atmosphere.

In a series of trials carried out on the plant by an eminent American steam engineer who had been specially sent over the water to investigate the system in July, 1912, it was found that, even with the boiler unlagged and when raising steam at a pressure of 100 lbs. only above that of the atmosphere, 92·7 p.ct. of the net heating value of the coke-oven gas was transferred to the water and sent out as steam; the over-all evaporation being at the rate of 14 lbs. per sq. ft. of heating surface per hour. The net efficiency of the boiler and feed-water heater, after deducting the power required to drive the fan, was certified to be 90·2 p.ct. After so successful a trial, a second boiler unit of similar size to the first was added to the plant.

As is often the case, the first attempt to translate a new idea of this kind into every-day large-scale practice was not altogether unattended with difficulties, the investigation of which taught me some valuable lessons. But the measure of success obtained over the period of about six years during which the installation of two boiler units put down was working, came up to my own expectations, and may be considered as having proved the soundness and practicability of the principles involved. Perhaps it will be useful if I briefly summarize the experience gained.

First, and most important of all, no difficulty was ever experienced with the boiler part of the installation, nor yet with the gas-feeding and combustion arrangements. The high thermal efficiency and heat transmission already referred to was consistently maintained throughout; and, owing to the rapid ebullition, the tubes kept clean and free from scale. There was also no trouble at all with priming. Moreover, notwithstanding the high rate of evaporation, the mechanical properties of the tubes were

* "Heat Transmission," by W. E. Dalby, Proc. Inst.Mech.Eng., 1909, p. 939.

not in the least impaired. Indeed, in 1917, more than five years after the first of the two boilers had been started up, the testimony of the management to me was that "the boilers themselves have proved all that you claim for them in efficiency and reliability. . . ."

The only real or serious difficulty met with in the installation arose out of the very efficient cooling of the products of combustion in the feed-water heater, and the consequent corrosive action of the small amount of sulphur oxides which they contained on the outlet tube plate, and on the fan mechanism beyond it. The average temperature of the products of combustion leaving the boiler when evaporating at a gauge pressure of 95 lbs. per sq. in. was almost 385° Fahr., or (say) within 15° Fahr. of the temperature of the steam. At such temperature they had no corrosive action whatever on the boiler tubes or plates. But in the feed-water heater, as originally installed, their temperature was reduced to about 200° Fahr., which was too low to prevent corrosive action on metal surfaces. Consequently, the outlet plate of the feed-water heater and the fan mechanism beyond it suffered rather severely. Had this been foreseen at the outset, we should either have omitted the feed-water heater altogether or installed a less efficient one, so as to keep above 350° Fahr. the temperature of the gases entering the fan. Such a precaution, together with the improved type of fans now available, would probably obviate the difficulties referred to.

My attention having been drawn to two criticisms which have been made recently about the Skinningrove type of boiler, I should like now briefly to answer them. It has been alleged that the use of the granular refractory packing occasionally gave trouble by breaking down owing to intense local temperatures developed by lack of free radiation from groups of particles; but, so far as my knowledge goes, this is untrue, and I do not believe it. The refractory packing was composed of irregular pieces of Glenboig firebrick, on the average about the size of a hazel nut, and so far as I am aware, it had not to be renewed more frequently than once a year when the boilers were laid off for the usual annual inspection. The other statement—to the effect that the use of an explosive mixture in the burners allowed back-firing to occur unless care was taken every time the burners were adjusted—is misleading, because the method of feeding the combustible mixture of gas and air on to the incandescent granular material in the front end of the fire-tubes was such as precluded the formation of an explosive mixture anywhere except in the short mixing-tubes (6 in. long by 1 in. diameter) leading into the fire-tubes, and then only for the last 2 or 3 in. before reaching the incandescent surface, where the combustion took place Such a short mixing-tube was fitted into the fireclay plug which formed the entrance to each of the 110 fire-tubes of the boiler; and only there in a very limited space (but nowhere else) could any explosive mixture possibly be formed.

Considering, then, all the circumstances of the case, and specially the fact that it was the first attempt to apply surface combustion to a large boiler fired by a dust and tar-free, but H_2S containing, coke-oven gas, I venture to think that the Skinningrove experience proved all the really material claims made by McCourt and myself for our system. And profiting by the lessons that flowed from it, I would myself have no hesitation in now proceeding to instal large boilers of the Skinningrove design, with some modification in detail, for either coke-oven or town gas, being confident of their exceptionally high thermal efficiency, rapid heat-transmission, and smooth working.

It should be borne in mind that such unsurpassed results as I have referred to were obtained with a tubular boiler only 4 ft. long, and I am doubtful whether such concentrated and intensive steam-raising and high efficiency in gas-fired boilers are possible on any other than surface-combustion lines. Recognizing the importance of the investigation of the matter being pushed forward, I am hoping soon to take it up again, specially in view of the recent work of Mr. Cox on radiophragms; and we shall welcome assistance from the engineering profession. For my firm belief is that the more completely the ideal of a flameless surface combustion, with its consequent high radiant effects, is, or can be, realized in gas-fired boiler design and practice, the greater will be the resulting rate of evaporation and thermal efficiency. I am prepared at any time to maintain my convictions by appeal both to well-established principles of combustion and heat-transmission and to the logic of achieved and verifiable results.

After Mr. Cox had given, with the aid of apparatus fitted up for the purpose, the experimental demonstrations of "radiophragm" heating, but little time remained for discussion.

Discussion.

Prof. Armstrong, proposing a hearty vote of thanks to the author, said he was sure they had all listened with great interest to Prof. Bone's modest and enthusiastic account of his progeny in its new pram. Personally, he could not help contrasting that evening with an unfruitful evening spent in the same place a few months ago, when the question of smoke abatement was under discussion. On that occasion, he had ventured to say that what was wanted was not punitive measures to prevent smoke, but constructive work to make the production of smoke unnecessary; and the paper which they had just heard was a first-class example of the kind of constructive work which was required at the present time. ["Hear, hear."] He had considerable personal interest in this invention, because he used to discuss its birth before it was born, and to urge the necessity of improving upon the miserable gas-stove which then existed and still did. Prof. Bone's early appliances were a wonderful success; and he had seen how well the boiler at Skinningrove worked. They had now been assured that the back-firing difficulty was at an end; and if this progress had been made, then much had been achieved. Personally, he had for years looked forward to the introduction of these appliances for domestic purposes, for the present ones were very inefficient. He would therefore like to hear something with regard to the improvements that had been made in bringing this apparatus into a condition for domestic use. He noted that it still had to be fed mechanically with air. One of the objections which might be raised against its application to domestic use was the noise of the electric motor and blower. His own impression was that they were going to use electricity for the purpose of utilizing gas. Most people were coming to believe that the method of illuminating by electric light was a mistaken one, and that gas was very superior as an illuminant. Only the previous night he had been visited by friends who were in the habit of using electricity. He had a single South Metropolitan incandescent burner; and they remarked upon the superiority of the light. Probably the sulphur dioxide in the air did infinitely more injury to vegetable life and dwellings than any smoke; and if the gas companies recognized that it was for them to produce all the fuel required in forms as free from sulphur as possible, then they would have reached the real millennium. He might say that the use of gas had done more than anything else towards reducing the deleterious sulphur dioxide content of the air. The thanks of the meeting were due to Prof. Bone for the enthusiasm he had displayed, for the way in which he had stuck to these problems of combustion when no one else had attempted to deal with them, and for the success which had attended his efforts. They congratulated him on the obvious improvements that had been made in the appliances.

Mr. W. H. Patchell remarked that they were all very glad to see Prof. Bone again taking care of his own child. It was a matter of regret that this subject of radiant heat had been allowed to rest for so long.

Major W. Gregson (Spencer-Bonecourt, Ltd.) said that, being very intimately connected with the modern Spencer-Bonecourt ("Kirke" patent) gas-fired boiler, which was the present-day representative of Prof. Bone's original steam generator, he would like to make a few remarks on the modifications his firm had found necessary in order to adapt the boiler to everyday commercial use. He believed he was correct in saying that a number of the original boilers were still at work in their old form; but in adapting the boiler to wider applications, they found they had first of all considerably to modify the burner arrangements. The original type of burner, as just described to them by Prof. Bone, meant individual setting of the tubes. In the case of some of the large boilers constructed recently by his firm, this would entail more than 500 settings; and they found in practice that it was essential to arrange the burners so that control could be effected by one main valve. This was particularly the case where varying loads had to be dealt with, or where varying gas pressure had to be allowed for. In the old-type boiler, it was found in practice very difficult to prevent back-firing when dealing with those variations. Turning now to the question of the refractory packing in the tubes, with anything but perfectly clean gas this packing was found to retain the impurities; and the resulting obstructions caused intense local heating, which eventually led to the fusing of the packing, and at the same time added to the pull required of the fan. He heartily endorsed Prof. Bone's remarks respecting feed-water heaters. His own Company had abandoned these owing to the corrosion trouble referred to in the lecture; but by re-designing the boiler heating surface, they were now able to get the same efficiency with the boiler alone as was originally obtained with the boiler *plus* the feed-water heater. Dealing with the question of fans, it would be noted that the Skinningrove boilers worked at 20 in. water gauge. This meant a very specially designed fan, and gave rise to certain mechanical troubles which were entirely absent from the new type of Spencer-Bonecourt boiler, which operated on 4 in. water gauge as a maximum, and in certain cases on natural chimney draught alone. He would like to make it perfectly clear that he was in no way disparaging Prof. Bone's work. In fact, Prof. Bone had no profounder admirer. It was interesting to note that his firm's boilers retained the high efficiency of Prof. Bone's original boilers. They would have been prepared to sacrifice a little efficiency to ensure mechanical advantages, ease of control, low first costs, and low maintenance charges; but fortunately practice had proved that it was possible to obtain all these desirable features, and yet retain high efficiency.

Prof. Bone said Prof. Armstrong had asked about the use of these appliances domestically. The appliances Mr. Cox was now making were fitted with very small fans, and there was no reason why they should not be used in houses, because the cost of the apparatus was not prohibitive, and the current required was very small. Major Gregson said that his Company were developing his (the speaker's) child. As to this, he said without hesitation that they had made a retrograde development. In his (Prof. Bone's) paper, he had told them that if one wanted the best results one must go to surface combustion. He did not believe that with any other system one could get the same results; and he had very good grounds for this opinion. He was going to take up surface combustion for boilers, and ventured to predict that this system would develop and become the premier system of gas-firing boilers. He was quite aware that they needed clean gas for their present system; but Major Gregson's criticisms he did not think quite fair. He was talking of boilers of the Skinningrove type, constructed to burn clean coke-oven gas. He (Prof. Bone) knew that when they made boilers for unclean gases they would have to have—and they were quite prepared for it—a different arrangement. But this criticism was made most unjustly about the Skinningrove type of boiler; and he was there to say that no such difficulty was ever met with in the Skinningrove boiler. He denied that there was any such trouble with that boiler, or that type of boiler, with coke-oven gas.

Mr. Patchell seconded the vote of thanks.

The Chairman, in putting the proposition to the meeting, said he was sure they had all learned a great deal, and had been extremely interested.

Prof. Bone acknowledged the vote, and proposed a similar compliment to the Chairman, which was heartily accorded.

SOCIETY OF BRITISH GAS INDUSTRIES.

ANNUAL GENERAL MEETING.

THE Annual General Meeting of the Society took place last Thursday afternoon, at the Holborn Restaurant. During the general business meeting, the chair was occupied by Mr. ALBERT CLIFF, J.P. (the Chairman of the Council). Subsequently the chair was taken by the Right Hon. Lord RIDDELL (the President), who delivered his address—this being his second year of office.

Apologies for absence had been received from the following: Sir Dugald Clerk, Sir Henry E. Duke, Sir Alfred Keogh, Sir Robert Hadfield, Sir Arthur Duckham, Prof. Arthur Smithells, Prof. Harold B. Dixon, Mr. J. D. Smith (President of the Institution of Gas Engineers), Alderman J. H. Lloyd (President of the British Commercial Gas Association), Mr. Samuel Tagg and Mr. James Paterson (Vice-Presidents of the Institution of Gas Engineers), Prof. John W. Cobb, Mr. W. E. Price (Hon. Secretary of the Institution of Gas Engineers), Mr. Thomas Goulden (Past President of the Institution of Gas Engineers), and others.

MINUTES OF LAST MEETING.

On the proposition of the CHAIRMAN (Mr. Albert Cliff, J.P.), the minutes of the last meeting were taken as read, confirmed, and signed.

REPORT OF THE COUNCIL.

The Council presented the following seventeenth annual report, dated April 27 and signed by the Chairman (Mr. Albert Cliff) on the work of the Society during the year 1922-23.

We have to record with regret the death of the following members:

Thomas Glover, Managing Director in London of Alder and Mackay, Ltd.

Thomas W. Fletcher, Chairman of Fletcher, Russell, & Co., Ltd.

Captain George E. Gibbons, D.F.C., M.C., a Director of Gibbons Bros., Ltd.

The Society wishes to offer its congratulations to the following gentlemen:

Sir Dugald Clerk, K.B.E., F.R.S., who has had the Albert Medal of the Royal Society of Arts awarded to him in recognition of his important contributions, both theoretical and practical, to the development of the internal combustion engine, which in its later forms has rendered aerial navigation possible, and is also so extensively employed in the motor-car, in the submarine, and for many other purposes; and the degree of Doctor of Science conferred upon him by the University of Leeds.

Sir Alfred Keogh, G.C.B., G.C.V.O., who has been awarded the Gold Medal of the Institution of Mining and Metallurgy on the occasion of his retirement from the Rectorship of the Imperial College of Science and Technology, in recognition of his great services in the advancement of technological education and as a mark of admiration and respect.

Alderman George Clark, J.P., M.I.Mech.E., elected Mayor of Chesterfield.

Business Generally.—There has been a somewhat improved demand for our various manufactures; but, so far as we have the power to penetrate beneath the surface of this increase in activity, only in a small percentage of cases is it possible to see much benefit. There are too many works in the country only partially employed; the cost of fuel is rising, traffic charges are still high, and wages keep up with the cost of living. We have not yet regained in full measure the will to work; and this, coupled with the shorter hours which now constitute a full week, makes it impossible for any manufacturer to meet the buyers' demand for low prices. The Council have continued to labour in all sorts of ways to make the best of a difficult year.

Ministry of Health and Loans for Extensions.—The position in regard to this has undergone a decided change for the better. We desire to thank Sir Arthur Duckham for valuable services in regard to this matter. With characteristic energy of mind, he was prepared with a plan. It is entirely owing to the situation having improved that further action in the matter has been suspended.

Revision of General Railway Classification of Goods.—The work of the Committee has been concluded, and our thanks are due to them for their services extending over many months. The traders are considerably indebted to Mr. Drage, of the Federation of British Industries, who has had charge of the arrangements and been present at the meetings between the traders, also the meetings with the railway companies, and at the Rates Advisory Committee hearings. This co-ordination has smoothed and considerably expedited matters alike for the traders, the railway companies, and the Rates Advisory Committee. In order to keep our members posted up with particulars of the various alterations in railway charges and as to how the arrangements for setting up the new classification and rates are proceeding, Mr. Holt, of Messrs. Tweedy & Holt, Railway Rate Experts, of Halifax, who has acted as Secretary to the Committee dealing with the railway classification matters, has kindly agreed to send us a quarterly report for our Bulletin.

Standard Gas-Valve Flanges.—The Sub-Committee dealing with the matter have had further meetings, and have now adopted a new standard for gas-valve flanges, which it is believed will be acceptable to the gas companies. The conclusions arrived at by the Sub-Committee have been approved by the Council, and a satisfactory conference was held with a Committee of the Institution of Gas Engineers, whose Council are in agreement with the standards proposed. The proposal has been finally approved by the Institution and submitted to the British Engineering Standards Association for adoption.

Revision of Standard Specification for Refractory Materials.—Conferences have taken place of the Joint Committee on Refractory Materials to bring the standard specification of fireclay goods up to date. The revision is about complete. For a considerable number of years the Society has co-operated in this important work. It is the only British standard.

Standard Conditions of Contract.—As the outcome of negotiations with the Institution of Gas Engineers relative to the restoration of the original figures in clause XXVII.—Payment, it has been agreed to revert to the original payment terms; and the standard conditions of contract with respect to this clause will now read as follows:

In paragraph	1	second line	80 p.ct.
,,	2	second line	10 ,,
,,	5	first line	5 ,,
,,	6	second line	5 ,,

Standard Gas-Cookers.—The report on gas-cookers of the Standardization Committee of the National Gas Council has been issued, together with the adopted specification, and fully reported in the Technical Press.

Gas Lighting.—A Joint Committee has been set up consisting of six representatives each of the British Commercial Gas Association and of the Lighting Section of the Society to consider what steps can be taken:

(*a*) Towards the standardization of the essential parts of the burners.
(*b*) Towards the elimination of shoddy burners, mantles, and fittings from the market, and
(*c*) Towards the maintenance and development of gas lighting.

Several meetings have been held; and good progress is reported.

Standard Inverted Incandescent Gas Burners.—During the year, the Committee appointed by the British Commercial Gas Association and the Committee of the Lighting Section of this Society have considered the question of standardization of inverted incandescent gas-burners, and a specification has been prepared by our Committee, and approved and accepted by the Association. We are now waiting for the acceptance by the Patent Office of a registered mark to be used for marking the standard burners; and as soon as this has been accomplished, the necessary steps will be taken by the Society to issue licences for the manufacture of standard burners.

Taper of Gas-Tap Plugs.—A Committee of the Lighting Section has been appointed to consider the question of the taper of plugs of taps for gas-stoves and fittings, which should have the effect of bringing the tapers into greater uniformity and produce a greater degree of efficiency.

Standard Capacity Meters.—The Life of Meters Committee presented their annual report at the annual meeting of the Institution of Gas Engineers. The last section of this report traces the origin of the demand for a standard capacity meter, the steps taken by the Committee in the matter, with particulars of the sizes of cases and connections and a comparative table of capacities and prices of the old and new types of dry meters. This section was considered to be of sufficient interest and importance to warrant its being reprinted in a convenient form and circulated to the gas undertakings of the United Kingdom. This has accordingly been done under the auspices of the Society; and copies of the pamphlet, which are still available, may be had from the Secretary.

Bulletin.—This has been issued quarterly; and the Council trust it has proved useful and interesting to the members. If members can find time to send an occasional paragraph of ideas bearing on the interests of the Society, or helping forward the solution of difficulties, or stimulating us with an occasional touch of always needful inspiration to do better—in short, anything calculated to make the Bulletin, within its limits, the chief oracle of its kind in the industry—such co-operation would be cordially welcomed by the Secretary.

Visits of Gas-Engineering Associations.—We note with pleasure the visits of gas-engineering associations to the works of the members. This practice should be widely encouraged. As regards the visits of the junior gas associations, it is in the power of the members of this Society materially to contribute to the education of the rising generation in the gas profession, by giving them some insight into the manufacture of products which they are destined either to distribute or to control.

New Offices.—Some time ago, Mr. Samuel Cutler, junr., a member of the Council, suggested the advisability of leasing fresh and more commodious offices. Suitable premises have now been acquired at No. 56, Victoria Street, Westminster, and the date of removal will be announced in due course. Our new headquarters are more spacious and attractive, and they are adapted for the meetings of the Council and for any prospective conference with kindred organizations. We hope to extend facilities to the members, enabling them to use them as a centre for business appointments. The Council feel that this provision will help to foster, and give added stimulus to, the work of the Society; it will augment the strength, give more scope and a healthier and more regular pulse. With this better equipment we shall do all we can, and all we ought to do, to make the gas industry of greater and still more commanding importance. We shall be in closer touch with others who have a common interest in the increasing success of this Society, and find ourselves not only better able to contribute to its executive and thinking life, but more effectively to co-operate in giving the industry new and improved elements of power and service in the days to come.

City and Guilds of London Institute.—The Society's prizes in connection with the City and Guilds of London Institute Examinations in gas engineering, gas supply, and gas fitting have been awarded, and duly

announced in the Technical Press. The Society wishes to accord its best thanks to The Right Hon. Lord Riddell for his valuable services during his two years' Presidency, and for his able address at the last annual meeting. On his retirement he has been pleased to accept the office of a Vice-President, and we hope that we may long have the benefit of his counsel and advice. We also desire to place on record our best thanks to Mr. Arthur Kitson for his interesting address on "Finance and Unemployment" at the autumn meeting, which led to a good discussion; also to Mr. Falconer Larkworthy for his pamphlet entitled "The Tools of Commerce." These gentlemen threw out a note of challenge, and fastened our attention on subjects of the greatest importance and matters we are prone to neglect.

The Council have much pleasure in announcing that the Right Hon. Lord Weir of Eastwood has accepted the Presidency of the Society for the coming year.

The New Offices.

The Chairman said he had now to propose the adoption of the report. He hoped those who had read it would agree that it was quite a satisfactory record of the year's work. There was one paragraph to which he would particularly call attention, and that was the one relating to the new offices. It would be seen that the Council, in their wisdom, had decided to move into that part of London where there was a good deal of executive energy in connection with gas matters; and this had been said to be very contagious. He thought they could take it that all their friends outside would be freshened up by this little enterprise on the part of the Council. In his opinion, it would add power to the Society; and they would fail in their hopes unless it also gave added force to the gas industry as a whole. ["Hear, hear."]

Mr. Frank West seconded the adoption of the report, which was unanimously agreed to.

Mr. Thomas A. Braddock next moved the adoption of the accounts for the past year. He remarked that they appeared to be in a very satisfactory state. There was a good excess of income over expenditure, and quite a respectable total standing to their credit.

Mr. H. J. Donkin seconded the motion, which was adopted.

The British Empire Exhibition.

The Chairman said that there was one other little matter to which he would at this point like to refer, as bringing the report of the year quite up to date. The Council had met that morning and considered certain suggestions and proposals that had been made to them, and unanimously passed a resolution which he proposed to read. It had reference to the forthcoming British Empire Exhibition, and was in the following terms:

> That, in view of the replies received from the members of the Society, regarding the supporting of the British Empire Exhibition, 1924, and also having heard a report of the Sub-Committee appointed to go into the question, it is resolved that the National Gas Council, the British Commercial Gas Association, and other associations interested, be asked to meet the Council of this Society to further discuss the matter.

Members of Council.

The Chairman said he had to announce that the following gentlemen had been elected to serve on the Council as representatives of the Sections:

J. Wilfrid Drake	Representing	Section I.
T. Alborn Clapham	"	" II.
C. A. Goodall	"	" III.
R. B. Hodgson, M.I.Mech.E.	"	" IV.
Lt.-Col. W. R. Glover, C.M.G., D.S.O.	"	" V.
James W. Wilson	"	" VI.
Philip H. Sugg	"	" VII.
E. J. Davison, M.I.Mech.E.	"	" VIII.
John Orme	"	" IX.
Thomas Allen	"	" X.
B. B. Waller, A.M.Inst.C.E.	"	" XI.
Norman Wilton	"	" XII.

New Chairman and Vice-Chairman of Council.

The Chairman said it was now his pleasure to move the election of Mr. Frederick C. Tilley, M.Inst.Mech.E., as Chairman of the Council of the Society for the ensuing year. The office was an important one, and one of growing importance. Coming events seemed to be casting their shadows before; and the year in front of them would afford plenty of scope for the executive ability (in which they had every confidence) of Mr. Tilley. All would feel confident that nothing would be wanting on his part to keep the wheels of the Society in action, and in progressive motion.

Mr. F. J. Gould, in seconding the proposal, said he had known Mr. Tilley for many years. Of quiet and charming manner, he possessed tact combined with sound business judgment, and would make an excellent Chairman.

The resolution having been carried with applause,

Mr. Tilley said he was very sensible of the honour that had been done him in electing him Chairman of the Council. He was also sensible of the responsibility which would thus rest upon shoulders which were becoming rather old and beginning to droop; but whatever he could do in the interests of the Society, he would be very pleased to do. He had had a good many years on the Council in one way and another; and it had sometimes passed through his mind that one method of getting rid of anyone was to make him Chairman, and then be done with him—because, having passed the chair, one naturally, after a year or two, went back among the body of members. During the time that he had been on the Council, he had worked in perfect harmony with his colleagues; and he was convinced they would support him in the chair as they had supported his predecessors. He was quite sure that in the next twelve months matters would come forward which would need a great deal of careful attention; and therefore he asked not only the Council, but the members also, for their full support. He was sorry to see there were not more member firms represented at the meeting that day, and hoped those who were present would urge their absent friends to attend as often as they possibly could. They wanted every member to attend the meetings, take a turn on the Council, and try to push the Society forward. It was now his pleasure to propose the election of Mr. J. Wilfrid Drake as Vice-Chairman of the Council. He felt that he needed the support of someone who was very strong; and in Mr. Drake he would have such a man. The Society, also, would certainly gain by having Mr. Drake as Vice-Chairman of the Council.

Mr. Samuel Cutler, jun., Assoc.M.Inst.C.E., seconded the proposal, which was unanimously agreed to.

Other Officers.

On the proposition of Mr. James W. Wilson, seconded by Mr. C. A. Goodall, Mr. H. M. Thornton, J.P., M.Inst.Mech.E., was re-appointed Hon. Treasurer.

Mr. F. J. Gould was re-elected Hon. Secretary, on the motion of Mr. Charles Clare, seconded by Mr. B. B. Waller, Assoc.M.Inst.C.E.

Alderman George Clark, J.P., M.Inst.Mech.E., proposed the election of Mr. Albert Cliff as an elective member of the Council. He had done well for the Society, and thoroughly merited this recognition.

Mr. Charles S. Bennett seconded the proposition, which was agreed to.

Mr. J. W. Broadhead, M.Inst.Mech.E., next proposed the election as elective members of the Council of Messrs. Cyril G. Davis, Charles S. Bennett, George Clark, and R. J. Milbourne. He said they would be doing the right thing in retaining the services of these experienced men on the Council.

This was seconded by Mr. John Orme, and passed.

On the proposition of Mr. R. B. Hodgson, M.Inst.Mech.E., seconded by Mr. John Orme, Messrs. Cash, Stone, and Co. were re-appointed Auditors to the Society.

Votes of Thanks.

Alderman F. Templer Depree, J.P., in moving a vote of thanks to the Council for their services during the past year, said he was very pleased to have this important duty placed in his hands. As one who had had long contact with the Council, he could tell them that this vote really did mean something, because those who attended the Council meetings had to give up considerable time, and in many cases to incur very considerable expense. Therefore it was no light thing to be elected a member of the Council.

Mr. T. E. Upjohn remarked, in seconding, that from his own experience he fully agreed with what Alderman Depree had said. All of them knew the important work the Council did.

The vote having been heartily passed,

The Chairman said he was sure he was speaking for all the members of the Council when he assured the meeting that they had been very happy to do what they could during the year. It was, as Alderman Depree had declared, no small task for some of the members to be on the Council—especially if they had to make very long journeys to town in order to attend the meetings. As long, however, as they managed to retain the support and the good opinion of their colleagues in the Society, every member of the Council would be perfectly satisfied. He then proposed a vote of thanks to the Hon. Treasurer, the Hon. Secretary, and the Secretary for their services during the past year. He had very great pleasure in testifying to their exceedingly good work.

Mr. R. J. Milbourne, J.P., F.C.S., Assoc.M.Inst.C.E., seconded the vote, which was cordially passed.

Mr. Arthur L. Griffith, in acknowledgment, said he had been connected with the Society for nearly seventeen years, and had seen it grow from very small beginnings to what it was to-day. He hoped that they would go forward, and do better still.

Mr. Cliff said he now had pleasure in asking Lord Riddell to take the chair, and deliver his address.

The Right Hon. Lord Riddell, who was received with applause, then proceeded to deliver the following

PRESIDENTIAL ADDRESS.

I am sure you will not expect me to address you on a technical subject; but as I happen to know something about selling goods, and advertising them, and as the gas industry, in common with other public services which have enjoyed monopolies, is emerging from the "take-it-or-leave-it" period, I have determined, with some hesitation, to say a few words on the trite subject of selling gas. My excuse is its importance to every section of the industry—manufacturers of plant and apparatus, gas engineers, and gas undertakings all depend for their prosperity upon the sale of a sufficient quantity of gas. A certain amount is sure to be sold; but adequate profits and adequate service to the public are only possible if the market is properly exploited.

Selling Gas.

During the past ten years, much has been done by the British Commercial Gas Association and by the more progressive gas

undertakings, such as the Gas Light and Coke Company; but still much remains to be done, and it is unfortunate that the activities of the "B.C.G.A." are hampered by insufficient funds. They have issued a number of valuable and instructive pamphlets regarding the use of gas, and it is a great pity that these are not more widely known.

With respect to these pamphlets, I would venture to say they are most instructive documents for those who possess the necessary technical knowledge to understand them. They are specially suited for architects, engineers, and others who are accustomed to read technical matter; but if I may respectfully say so, they are not so well suited for the ordinary man who requires plain, simple, direct, definite information, and who is not prepared, I regret to say, to read anything which is voluminous or intricate, or which makes any special call upon his brain power.

There is, however, one matter for congratulation. I say this, as I have recently been engaged in several building operations. The modern architect is usually well acquainted with the various appliances and devices for the use of gas for lighting, heating, and cooking; and this knowledge is due in a great measure to the remarkable work of the "B.C.G.A."

Educating the General Public.

My object is to advocate improved educational methods for the general public. The ordinary man or woman is sadly ignorant of the latest improvements in gas appliances. Much may be done through the medium of the Press; but the information must be simple, short, and non-technical. It must also be definite. Like most other good things, Press advertising requires to be used in a proper way. I wrote Mr. F. W. Goodenough—and I should like to take this opportunity of saying how greatly indebted the gas industry is to him for the admirable work he has done in advertising gas—and told him I had been reading those pamphlets which he had been good enough to send me. I suggested that it would be a good plan if he and others interested in the gas industry were to have some clear, bright, definite articles written for the Press, indicating the best sorts of appliances for various purposes in a house. Of course, the manufacturers, who would benefit by this advertising, would have to bear a part of the expense.

What the ordinary man or woman requires to know is what is the best appliance for a particular object. The public want to know what is the best burner, what is the best gas stove for a certain purpose, what is the best circulator for a house of a certain size. If cleverly constructed articles such as I have indicated were written and widely advertised in the Press, I have no doubt the results would be most remunerative, and that the gas industry would flourish in consequence even more than it is flourishing now. And having secured the requisite information as to the best burner, cooker, &c., for his purpose, the consumer does not want to be met with hindrances on the part of the gas company in whose district he resides. In short, if you want to sell gas to the best advantage, you must make things easy for the customer, and must see that he gets the best appliances available. Many people who possess antique stoves, burners, or heaters, fear to change them because of the expense. Here the customer requires to be reassured by statistics, showing that he will soon save the present outlay by increased efficiency and future economies. And when all is said, the most important item in the programme should be a capable, well-informed inspection and selling staff, whose duty it should be to make periodical visits to every house and business premises in their company's district, with a view to inspecting and advising on the apparatus and suggesting the extended use of gas, when desirable.

Training Sales Staffs.

The formation of such a staff is difficult. The man who has the technical knowledge is often not a good salesman; while the good salesman frequently lacks the technical knowledge. What you want is a combination of the two. This is a matter of training. In America now-a-days, as you probably know, most great undertakings have training schools for their salesmen and saleswomen, in which they teach not only the technique of the business, but the art of dealing with customers. The gas companies would do well to form schools of the same kind.

I am glad to hear that the Institution of Gas Engineers, in co-operation with the Board of Education, are just launching an improved educational scheme for gas engineers, and that the British Commercial Gas Association are busily engaged on plans for a general scheme of education on the commercial side. These evidences of progressive thought and planning promise well for the future of the industry.

When I was in America, I happened to come across the instructions issued by a hotel proprietor to his staff. The first instruction was: "The customer is always right." I have noticed in my dealings with gas companies that this spirit is not usually displayed. Gas industries in the past have been monopolies; and members of the staff have been accustomed to deal with customers on this basis. This they can no longer do; and the time has come when, if the gas companies wish to do the best they can for their shareholders and their staffs, they have got to humour and educate the public. My attention was first drawn to this subject by personal experience. Having long suffered from bad gas lighting, I lodged a complaint when I attended the wonderful "gas dinner" in Bristol, and ventured to suggest that according to my experience the days of gas as an illuminant were rapidly drawing to a close. Some of my gas friends took up the challenge, and made an inspection of my burners, with illuminating results. They proved that my suggestion was wrong, by providing me with new burners of the existence of which I was not before aware. Now the light is brilliant, whereas formerly it was of the poorest description, although the apparatus had been inspected by the gas company on many occasions, and although frequent complaints had been made. This shows the advantage of intelligent advice. Since then many of my neighbours have expressed astonishment at the excellent lighting of my rooms, and a desire to follow my example. That is my experience; and since then I have found that the trouble of having bad gas-fittings, and not knowing how they should be replaced, is quite a common one.

Most people do not realize the overwhelming importance of using proper fittings; and until now very little has been done to educate them. For example, the ideas of the man in the street concerning incandescent gas lighting are of the most primary description. Then again, few people realize the enormous advance which has been made in the efficiency of gas for street-lighting; and judging from results, many local authorities who use gas have not availed themselves of the most modern appliances. I have had many arguments about the gas lighting in Parliament Street. Most people believe that it is electric lighting.

The gas industry and its allied trades are making great strides in technique. It is equally important that gas companies should improve their commercial, selling, and educational methods. It is not enough to tell the public that gas can be used with advantage for a certain purpose. They must be shown how it can be best used, what are the best appliances, and so forth. And for its own credit and advantage, the company serving them must see that they get the most efficient, and that these are maintained in proper order.

Well, gentlemen, I hope you will forgive me for having ventured to make these few observations. I can assure you that they deal with a matter of great importance. You are all so much engaged with your own technical affairs, and you know so much, that I sometimes think you do not appreciate how little the public know, and how they ought to be educated.

My Presidency of this body has given me great pleasure; and I may say that I have learned a good deal by associating with your members.

The New President.

The PRESIDENT (continuing) said the Society were fortunate in having as his successor Lord Weir—[applause]—who was a remarkable person. He was a great engineer; and he was one of the men who carried the flag of British commerce to all parts of the world. But he was something more than this. He was a man with ideals, and a man who during the war set his own business aside and devoted his great talents to the service of his country. It was difficult to realize that under Lord Weir's mild exterior there was a blazing courage and burning enthusiasm which made him successful in everything he undertook. It would be possible to dilate for a long time upon his exploits during the war. He had never scrupled to risk his life. He had taken many risks; and it was a wonder he was with them now. He was just the sort of man they should have chosen for this office—a man of vision, a man of energy, a man of enterprise, and a sportsman. Some people said that the men of to-day were not equal to the men of the past. It was not true. One had only to look over the men of this country, and to examine those connected with any of the great industries, and it would be found that the Briton of to-day was fully equal to his ancestors. In Lord Weir they had one of the most distinguished, and at the the same time one of the most modest, men of the era. It was a great pleasure—and he deemed it a great honour—to ask Lord Weir to succeed him in the chair. He had not the slightest doubt that Lord Weir would bring to their deliberations much knowledge which they would find extremely useful.

The Right Hon. Lord WEIR OF EASTWOOD (who was greeted with loud applause on taking the chair) said in the first place he would like to thank the President for his very kind remarks. They were far too flattering, for nothing he had done had ever merited them. To all of them he expressed his hearty thanks for their most cordial and generous welcome. They had done him a great honour in choosing him as their President for the coming year. He regarded it as a very great privilege. He appreciated the confidence they had reposed in him, and hoped he was conscious of the responsibility he was assuming. If anything had been required to bring this responsibility home to him, he thought it would have been supplied by the admirable address to which he had listened with much enjoyment. He knew now the level he had to live up to. But if Lord Riddell had told them how to sell gas, he hoped they would not expect him (Lord Weir) next year to tell them how to produce it. The one obvious and clear matter which emerged from Lord Riddell's address seemed to him to be that some enterprising individual should now suggest that Lord Riddell, having retired from the Presidency of the Society, should accept the Sales Managership of one of the large gas companies. [Laughter.]

Lord RIDDELL: I am open to an offer.

The PRESIDENT (continuing) remarked that, when he looked over the list of his predecessors, he felt that as a Society they had every reason to regard themselves as fortunate; and he was proud to have his name added to so distinguished a list. He rather wished that he had had a closer association with the work of the Society, so that he might have known the members better before coming among them as their President; but this difficulty he

would endeavour to overcome in the next twelve months. To the best of his ability he would devote himself to furthering the interests of the Society and of the great industries they represented.

Lord Riddell's Services Acknowledged.

Mr. Cyril G. Davis, M.Inst.Mech.E., said it afforded him very great pleasure to propose a vote of thanks to Lord Riddell for his address and for the services he had rendered to the Society during the two years in which he had occupied the position of President. Lord Riddell had proved a very wise counsellor and a great friend to the Society. They much appreciated the keen interest he had shown in all matters connected with gas. When he first asked Lord Riddell some two years ago (while playing golf at Walton Heath) whether he would become President of the Society, Lord Riddell said he would think it over. They were all very glad indeed now that he had consented to do so. He had acquired an expert knowledge of gas more quickly than anybody they had ever come across before. It was a good thing for the industry that there was a man of keen intellect like Lord Riddell who would interest himself in the subject to which they were all so closely allied. His address was a most interesting one. He had shown them "the other side" of the picture—the side from which the public saw it. He thought Lord Riddell had an impression at the back of his mind that the gas companies were not as enterprising as they should be; but he would inform Lord Riddell that the gas companies to-day ran their business as a business, and not as a monopoly. The majority of the gas companies in this country possessed an efficient outside staff, who watched everything that was going on. They were watching for opportunities of installing gas and gas apparatus. Whatever the position of gas undertakings might have been in the past, the business was not regarded as a monopoly to-day. He did not think it could fairly be said that gas concerns were behind the times. In fact, the particular Gas Company to which Lord Riddell had referred were very up-to-date, with men as keen on pushing gas and gas appliances as were any men in the country.

Alderman George Clark, in seconding, said he specially wanted to be associated with this vote, because last year, when he was relinquishing the position of Chairman of the Council, he was in a great quandary. It had been the practice to change the President year by year; and he had been endeavouring to get a new one. When he arrived at the annual meeting, he had found no one to carry on for the next year; but when approached, Lord Riddell at once agreed to undertake a second term of office. He was extremely grateful to him for having done so. No one could have filled the office in a happier or more congenial manner than he had. They had been able to appreciate fully his keen brain and the great work he was doing. In all sorts of ways, Lord Riddell had been an important man to this country.

The vote having been carried with acclamation,

Lord Riddell said he was very much obliged for the kind remarks that had been made about him. His term of office had been of an educative character. One could not know this great country unless one came into touch with the various staple trades and industries; and the only way of doing this was by mingling with the people conducting them. They all led such sectional lives that very few of them knew much beyond what concerned the particular industry in which they were engaged. He had learned many interesting things since he had been connected with the Society; and he hoped they would on future occasions give him the opportunity of meeting them again.

Vice-Presidents.

The following is the list of Vice-Presidents of the Society:
Sir Dugald Clerk, K.B.E., F.R.S.
Mr. Charles Clare.
Prof. Arthur Smithells, C.M.G., F.R.S.
Prof. Harold B. Dixon, C.B.E., Ph.D., F.R.S.
Surgeon-General Sir Alfred Keogh, G.C.B., C.H., G.C.V.O.
The Right Hon. Sir Henry E. Duke.
Sir Robert A. Hadfield, Bart., F.R.S.
Sir Arthur Duckham, K.C.B., M.Inst. C.E.
The Right Hon. Lord Riddell.

The Dinner.

The dinner in the evening was an enjoyable function. Lord Weir of Eastwood, the new President, was in the chair. To his right-hand side were: Mr. Albert Cliff, Mr. F. C. Linfield, M.P., Alderman George Clark, Mr. D. Milne Watson, D.L., M.A., LL.B., President of the National Gas Council, Lieut.-Col. C. F. T. Blyth, C.M.G., LL.D., Mr. Samuel Cutler, jun. To the left-hand side of the President were: Captain Wedgwood Benn, D.S.O., D.F.C., M.P., Mr. F. C. Tilley, Mr. Thomas Hardie (late President of the Institution of Gas Engineers), Mr. Charles Clare, Mr. J. W. Broadhead, Mr. F. W. Goodenough (Chairman of the Executive Committee of the "B.C.G.A."), and Mr. Cyril G. Davis. The Vice-Chairmen were Mr. B. B. Waller, Mr. Charles S. Bennett, Mr. J. Wilfrid Drake, Mr. R. B. Hodgson, and Mr. A. W. Glover. After dinner there were toasts and music—an excellent programme for the latter having been arranged by Miss Millicent Russell, of 45D, Colville Gardens, W. 11. The artistes were Miss Bertha Steventon, Miss Millicent Russell, Mr. Stuart Robertson, and Mr. Middleton Woods of the Follies. The accompanist was Miss Winifred Gardiner.

The Loyal Toast was duly honoured.

"The Society of British Gas Industries."

Captain Wedgwood Benn proposed the toast of the Society. He said the work of the organization as he understood it, or rather the leading impulse on which the Society existed, was the two themes—co-operation and education. These were great themes. If they looked round the world that day, and saw the disorder or chaos that existed, they could trace it to the lack of education and real understanding, together with a shocking want of co-operation unparalleled in the history of the world. There was no time when co-operation in industry was more essential than to-day. There had never been a time in the history of the world comparable with the last eight years as to relations between Government and industry. He should not like to think of how many great industrial magnates had trembled before their President when he was in supreme control of one of the great departments of State. War brought the Government and municipalities into closer touch with industry; and if they were to do their best, it was absolutely essential that they should have co-operation among themselves for the purpose of conducting negotiations. The co-operation in which the Society were engaged, he was told, found its expression in schemes for dealing, among other things, with the great and pressing problem of unemployment; and the Society had proposed some way in which the Government could be of assistance in industry. Personally, he was not a great believer in the power of Government to assist industry; he believed that the experience of industry was that Government interference was a hindrance rather than a help. ["Hear, hear."] He was going to couple with this toast the name of Lord Weir. He need not say very much about him, as his name was, in the copybook phrase, "a household word" in this country. He was known as a great and successful leader in industry; he was known also as a public servant, who had rendered incomparable help to his country in the hour of her greatest need.

Lord Weir, in reply, said he felt sure those present would join with him in recording sincere regret that their distinguished President, Lord Riddell, was unable to be with them that evening. When he recalled his suggestive and interesting remarks of that afternoon, he felt his personal regret deepened by his consciousness of the inefficient substitute who had been called upon at short notice to deputize for him on this occasion. He should have preferred before assuming the presidency to have served his time with the Society as an apprentice member, so that he might have learned more of the Society, its work and activities, and, might he say, of the atmosphere of its annual dinner. His lack of knowledge in regard to the gas industry was colossal. For example, he was aware of bitter and acrimonious discussion—even in the ranks of the gas profession—as to something called a "therm;" and he hoped that, before the evening was over, he would learn something more of its nature, its sex, and how they educated it. [Laughter.] However, his first duty was clear and definite, and that was to express on behalf of the members their great indebtedness to Captain Wedgwood Benn for his kindness in joining them that night, and for the appreciative remarks he had made as to the work of the Society, and the good wishes he had expressed for its future. He also wished to thank him for his kind personal references. Might he say that his remarks combined in themselves the brilliancy of his personality, and the warmth of a generous heart; and so they were specially welcome in a gathering such as this. Of his association with the gas industry, he (the President) had not the same knowledge as of his activities in other spheres; but he would recall that, in his distinguished career, there had been no brighter page than that which recorded his work in the higher altitudes of the atmosphere. He had referred to the progress and usefulness of the Society and of the industries with which it was associated. He observed from the Press that a recent discovery had enabled the carbon monoxide in ordinary gas to be practically eliminated, so as to render it innocuous to human beings; and it had occurred to him that Captain Benn might have moments at Westminster when he must doubt the value of this discovery, and question the compensations of such progress. He (the President) feared his native city was not so popular in Westminster as it used to be. [Laughter.] Progress was not an easy thing to define or to assess. Someone once said that it was a thing which must be achieved whether it was wanted or not. Now, Captain Benn was aware of spheres of human activity where that definition was accepted and acted upon; but that in the gas industry they could only record their progress in the form of deed and performance; and these were assessed by the hard figures of cost or efficiency of their products. In their case, if they failed, the responsibility was definite, and the penalty was rapid and effective. In times like these, when progress could only be achieved in the face of abnormal difficulties in the national economic conditions, when they lived on an island surrounded with hot water [laughter], it was useful—it was even valuable as an antidote to pessimism—to remember that, after all, they were doing more effective work than any other country to regain stability and revitalize enterprise and industry. Prominent among the factors essential to secure this, must be the continued development of their technical efficiency. With superiority in technique, with the inventive and scientific capacity to pioneer new developments, they would assuredly build on a sound foundation; and at no time in history had technical efficiency in the gas industry had behind it more compelling forces than to-day. It would be merely presumptuous of him to indicate to those who lead the industry any particular line of guidance; but there was one factor which seemed to him worthy of special import at the present time. He referred to the interlocking of the gas industry with other industries. As the source of an infinite number of products, it permeated the whole structure of their civilization in transport, power, agriculture, and manufacture; and in this way it exemplified, and was, he felt, the pioneer of, the coming era of interdependent industries. Practically no great industry to-day formed a complete and self-contained activity; and the effective linking-up through what they falsely, he thought, called bye-products, was an increasingly important feature of our economic structure. He believed they were hardly aware as yet of the full possibilities of the economy which was latent in a better correlation of industries. For example, he was told that the total cost of production of a Ford motor car was less than a British manufacturer would require to pay for the semi-raw material contained in it. The

only explanation of this phenomenon must be in the capacity of the Ford organization to interrelate the entire range of the industrial activities involved, all the way through from the coal and iron ore. Might he also cite the situation in the Ruhr, Westphalia, and Lorraine as an interesting example of the disastrous effect of severing the economic unity. ["Hear, hear."] But in all these matters, considered either from the industrial or the political aspect, they must avoid any tendency to look for solutions of their problems by some short cut, some easy way, or some formulæ of words alone. As engineers or chemists, their experience had shown them that nothing could take the place of patient and resourceful application and hard work. Instead of looking for formulæ, let them get down to the bed-rock matters which caused waste and increased cost; and they would surely find that energy and ingenuity would enable new savings to be realized, which would quicken the demand for products and bring about an improvement in the conditions of the workers. But however high they might put these ideals, they had to reckon with human nature. It was the raw material of organization; and it responded slowly to change. To obtain that response, incentive was essential. Accordingly, it was useless to expect brains to do their utmost and display their energy and enterprise under the shadow of changes in their social system, under changes based on some new notion of community or social service. It simply would not work; and moreover, there was no halfway house in which to rest between socialism and private enterprise. ["Hear, hear."] In the best interests of industry, it was essential that industrial problems be left to those engaged in them. The realization of this was gradually being appreciated; and if they could all of them look forward to a future holding of their freedom to develop along the best evolutionary lines which had served so well in the past, then he foresaw for industry as a whole and for the gas industry, which they had so cordially toasted that night, not only a bright future, but one which could be termed progressive in the best senses of the word.

"KINDRED ASSOCIATIONS."

Mr. ALBERT CLIFF proposed the toast of "Kindred Associations." He said that during his Chairmanship in the past year, he had been able to make closer acquaintance with the kindred Associations; and the usual thing had happened. He found serving on those bodies gentlemen who knew a great deal more about some things than he did. Perhaps there were other things in which he should be inclined to rely upon his own intelligence; but he thought, after this experience, one was less ready to challenge the policy of these Societies, because—having been nearer to them, and having occasionally had a little frank and searching talk—experience seemed to be that, in nineteen cases out of twenty, the policy of a Society which they were inclined to dispute was the right and approved one. Generally his knowledge of this Society brought him to one general conclusion. It was that wherever there existed a gas society, and where men were from day to day honestly facing its problems—legislating for the public, thinking out how they could extend the uses of gas—then he thought it was a benefit to the whole of the gas industry, and to the community at large. Every member of these kindred associations might be taken, he thought, as having some stake, direct or indirect, in this great industry; and it was only as those gentlemen were willing on occasion to take their eyes (so to speak) from the narrow view of the cultivation of their own particular stake, and as they were willing to get behind the industry as a whole and give it a push along, that those interests represented by the various members were likely to come to fruition. Therefore he looked to the members of those Societies to do what they could in future to lift gas to a higher and stronger platform than ever it had occupied before. Thinking about this subject himself, he felt that, after all, gas was yet only at its springtime; and they were all conscious of a sense that they wanted to realize they were growing. Whether or not they grew, depended upon the men who constituted these Societies being willing to put in their best from time to time; and this was the time for exertion by those who were interested in the progress of gas matters. He was afraid they were apt to lose their faith in the capacity of separate societies for real improvement. He urged, therefore, that they should see as much as they could of each other, and try to understand each other better. And, if there were any duties that any one of these kindred associations was called upon to perform, in which they could all help, then he urged them to do it, and to show progressively a rising standard of work. He coupled with the toast the name of Mr. Milne Watson, President of the National Gas Council.

UNION IN EFFORT—EMPLOYEES AS HOLDERS OF CAPITAL.

Mr. D. MILNE WATSON said he had great pleasure in responding to the toast so eloquently proposed by Mr. Cliff. There were quite a number of kindred Associations—the National Gas Council, the Federation of Gas Employers, the Institution of Gas Engineers, and the British Commercial Gas Association—and he supposed he might also include the Sulphate of Ammonia Association. He felt that to reply properly to a toast of this kind would require an almost universal knowledge of the activities of the great gas industry. However, he was not called upon to do more than return thanks for the way those present had drunk the health of the various kindred Societies. They were all trying to do their best; they were all trying to help forward the great industry with which all present were connected, and, though there did not lack critics of the various bodies, he was sure from the way the toast had been received that they believed the members of the kindred Societies were trying to do their best to help forward those things which promoted the progress of the industry. One often heard—all present had no doubt heard—about the value of union. He himself believed implicitly in it. It was only by union that they could withstand the numerous attacks constantly being made upon the industry. These, he was sure, were frequently ill-founded; and he was equally certain that sometimes they were due to a great lack of knowledge, and sometimes even to malignity. They had had the question of the therm, also of carbon monoxide, and other matters had been from time to time brought before the public. To-day more than ever they all believed that it was absolutely necessary that the industry should stand before the world as a united body. Views varied as to the forms of organization which were best. He was not one of those who believed in constant "constitution mongering;" and he believed they had at the present time organizations which filled the rôle that each was called upon to play. Therefore, he said, let them go forward on the road on which they found themselves—each Society doing its best in the best possible way. Now there was coming along an opportunity for them to unite in a single endeavour—that was, at the forthcoming British Empire Exhibition. He was not there that night as a canvasser, nor did he in any way make any particular financial suggestion. But he would ask them all seriously to reflect that it was very necessary that the industry should join together to make the Exhibition a great success. He presided at a meeting the other day at which he was glad to say they decided as an industry to go in for a gas exhibit. He was speaking not for himself alone when he said that not one of them with any sense of responsibility would enter into this piece of enterprise unless he intended to make it worthy of the great industry with which they were connected. He hoped, therefore, that they would all be united by goodwill, and try to view this matter from each other's point of view, as well as from their own, and so make the exhibit expressive of the industry which they served. Lord Weir had talked about the necessity of co-operation, and he had spoken of socialism. He agreed with every word that their President had said on these points; but might he be allowed to say a few words on one aspect of the subject. He referred to that part of the gas supply industry which had adopted co-partnership. It was no use to-day going about the country talking about the inestimable blessing of capital, and the inestimable work that capital did; for the great bulk of their employees did not understand what was the meaning of the word capital. It was no use talking about the great advantage of capital to men who had no capital at all. The gas industry had led the world in this particular matter; and he was sure that the gas manufacturing companies connected with the Society of British Industries would, in the course of time, see that it was to their advantage to spread co-partnership in every direction. They could never persuade a man that capital was good unless they gave that man himself an interest in capital. When they realized that the Gas Light and Coke Company (this only by way of illustration) alone employed some 15,000 workmen, and that each of these men represented (say) a family consisting of a wife and three children, this meant five times 15,000 who were interested in the welfare of the Company, and so in capital. The Company served a population of some three millions; this meant that one person in every forty within the limits of their district was directly interested in capital through the influence of the Gas Light and Coke Company. Of course, this entirely ignored all those who were interested in the Company as ordinary or preference shareholders, or holders of loan capital. If every company did their little bit, as so many of the great companies in the gas industry were doing, it was easy to see in what a different aspect capital would be regarded to-day. He felt this very strongly; and he did think this was an opportune moment to give vent to these views. [Applause.]

"THE VISITORS."

Mr. F. C. TILLEY proposed the toast of "The Visitors." In doing so, he said he was sure that it would be received with the greatest of enthusiasm. The previous toast had dealt with "Kindred Associations" in general; this toast dealt with representatives of those kindred Societies and other persons who were present honouring them by joining them at their festive board. He was sure it was unnecessary for him to say much to express to these gentlemen that the members of the Society appreciated highly the honour the visitors had conferred on them; and they welcomed them very heartily. They had with them Mr. D. Milne Watson, the President of the National Gas Council and the Governor of the Gas Light and Coke Company; and they were very much obliged to him for having, in view of the multifarious character of his duties, spared the time to be with them that evening. Unfortunately, the President of the Institution of Gas Engineers (Mr. J. D. Smith) was unable to be present, but they had the Past-President (Mr. Thomas Hardie) with them; and they thanked him for coming among them that evening. Some of the members of the Gas Council were also present; and there were representatives of other kindred Societies. It was indeed a great pleasure to have all these gentlemen with them on this occasion. He asked the members to drink very cordially to the health of their visitors; and he coupled with the toast the name of Mr. F. C. Linfield, M.P.

Mr. F. C. LINFIELD, M.P., rising to reply, confessed embarrassment at having such greatness thrust upon him. He was expected to reply for all those embodied in the toast; but his only qualification was that he knew nothing about gas. However, he had once been Chairman of an Electricity Committee. Even so, he felt that electricity had been of great service to the gas industry, for it had given the gas industry a new lease of life. He thanked the company for the hearty reception accorded the toast of the visitors. Personally, his only connection with gas was as a humble consumer; but the latter's importance almost led him to put in a plea on the consumer's behalf. [Laughter.] Referring to co-partnership, he could remember a certain strike, and he could remember George Livesey, and how he had dealt with that strike; and since then, he had watched with pleasure the results of his work. They must not be afraid of socialistic talk—perhaps it was the only way of getting into the Press!

"THE NEW PRESIDENT."

Alderman GEORGE CLARK, J.P., M.I.Mech.E., Mayor of Chesterfield, then rose to give the toast of "The New President." It was, he said, a privilege to propose the toast; their Society possessed a long and distinguished list of Presidents, but none more distinguished than Lord Weir of Eastwood. He would remind them that he was the head of a great undertaking in Glasgow, which employed 3000 hands and was a model of efficiency and management. When, in war-time, the country cried for super-men, Lord Weir was one of those who answered the call; Sir Arthur Duckham was another. Their President's well-merited reward had been a peerage. He represented an industry to which they all belonged—engineering; and here they were all gathered together as plain men, to understand each other. Detailing his many decorations and accomplishments, the speaker said they

were fortunate to have Lord Weir as their President, especially as a great industrialist and one who was keen on bringing employer and employee together. They welcomed him.

The President briefly responded, voicing his appreciation of the kind things that had been said, and of the warm reception accorded him. Certain references had been made to his past; but as for the present and the future, he had come as an engineer among engineers, and had still to make a reputation among gas engineers.

The proceedings then terminated.

EASTERN STATES GAS CONFERENCE.

The Eastern States Gas Conference is a new geographic section of the American Gas Association. The idea underlying its formation was to bring the advantages of a gas convention to the rank and file in the industry, who, in this country of magnificent distances, can afford neither the time nor the expense of a trip to the annual meetings of the national association.

The first meeting of the Conference was held in Philadelphia from April 11 to 13. The following subjects were discussed. "House Heating with Gas Fuel," "House Piping," "Water Heating by Gas Fuel," "Gas-Meters," "Employees and Public Relations," "Gas-Lighting—Demonstration and Exhibition," "Gas-Ranges." From one to two hours were devoted to each subject, which was presented by several prepared addresses of about ten minutes each, and then thrown open for general discussion. However, it was not these subjects, nor the way in which they were handled, that distinguishes the Conference from past gas conventions, but the character of the attendance.

As to this attendance, let us first quote the President, Mr. P. H. Gadsden, on the reasons for the organization of the Conference: "What the American Gas Association does for the officers and managers of gas companies, the Eastern States Gas Conference proposes to do for the employees generally in the States of New Jersey, Pennsylvania, Delaware, Maryland, West Virginia, and the District of Columbia. The plan contemplates that each gas company in this territory shall send from the body of its employees a definite number to the three-day sessions of the Conference—meter readers, complaint men, book keepers, salesmen, fitters (employees who come into personal contact with the consumer), the men and women who in reality represent the gas company in the eyes of the public. At these sessions, in addition to discussions about meters, main extensions, and water heaters, and the probability of using gas for heating houses, they will, for the first time, hear something about the economic principles underlying the gas business—the necessity for rates, which in addition to covering operating expenses and interest and dividends, shall be sufficiently attractive to induce into the gas business the large amount of new capital required each year to keep up with the growth of the communities in which they operate, the injurious effect of the continued issuance of tax-exempt securities upon public utility financing, and many other questions of national importance, which up to the present have been reserved for the consideration of the officers and directors. A force of employees so trained and inspired will be prepared to answer correctly the questions of consumers about any phase of the company's business, and will help in gaining for the company the goodwill of the public."

So much for the plan. Now for the fulfilment. The Philadelphia Gas-Works sent over one hundred employees of various ranks; and the other companies of the Conference were represented in lesser numbers, depending on their size and distance from Philadelphia. The total registration approached 700; and there is no doubt of the benefit derived from the meeting.

Coal Storage Survey in the United States.

The Executive Board of the Council of the Federated American Engineering Societies have decided to undertake a national coal storage investigation. The moment is felt to be opportune for an engineering body carefully and painstakingly to survey the entire subject of coal storage. Both the Coal Commission and the Department of Commerce are making studies of certain features of the coal industry; but neither will be in a position to give sufficient consideration to the engineering and economic phases of coal storage. The precise object of the now suggested survey is "to determine the facts relating to the engineering, chemical, and economic considerations involved in, and their influence upon, coal storage at the mine and by large and other consumers." The Executive Board say many have contended that a larger practice of storing coal by consumers would materially reduce the intermittent aspect of the coal industry; would result in an ample supply of coal at all times; would even-up the demand for transportation facilities; would enable a larger resort to water transportation; would reduce operating and transportation expenses; and so would lead to a reduction in the cost of coal to the consumer. No adequate comprehensive study of the various engineering and economic factors has been made, whereby a definite conclusion relating to the various advantages claimed for coal storage might be drawn. It is thought, therefore, that a careful study of the engineering and economic phases of coal storage would be timely and important, and would inevitably be of value.

CORRESPONDENCE.

[*We are not responsible for opinions expressed by Correspondents.*]

Practically Testing and Rewarding the Ability of Gasfitters.

Sir,—The remarks on the above subject in your issue of May 2 interested me greatly, chiefly because, during the past few years, I have acted many times as Local Examiner in this centre, and have been struck with the inadequacy of the tests and questions as an index of the candidate's ability.

Unfortunately I was not asked to attend the meeting of Local Examiners in August last; otherwise I should have agreed that an inspection of the candidate's work on the district was essential, and further would have suggested that the selection of the work to be inspected should be left to the discretion of the Local Examiner, and not to the candidate's foreman. I should have suggested that the employer be asked to submit a statement of all the important jobs carried out by the candidate during the previous three months, together with a description of the work, a brief specification of the quantity and size of materials used, the time occupied, and the class of assistance given to the candidate.

The Local Examiner could then inspect as many jobs as he thought necessary, instead of, as at present, being compelled to judge a candidate's ability on an inspection of two or three specially selected jobs of a comparatively simple nature.

I think most Local Examiners will agree with me that work on the district is more important, from an examination point of view, than test questions. This is chiefly owing to the lack of variety of the tests and of the *viva-voce* questions. The same kind of test and questions crop up year after year like hardy annuals; and it is only by supplementary questions that an examiner can judge a candidate's ability.

May I say that the all-round ability and adaptability of the average gasfitter does not reach the same standard of craftsmanship as is shown by other tradesmen, such as joiners, masons, blacksmiths, &c.; I wonder how much of this is due to the growing practice among gas undertakings so to sectionalize that a fitter becomes an expert in fixing cookers and fires and a "dud" in fixing meters—who is a capable fitter for lead work and all at sea at laying wrought-iron piping—who can describe exactly how a meter works, but has no idea of the number or size of burners required in a room of a given size to give 3-ft. candles illumination?

Wm. M. Barrett.

Manchester Corporation Gas Department,
Town Hall, Manchester, May 7, 1923.

Richmond Gas Company.

Sir,—I wonder if the shareholders of the Richmond Gas Company are aware that under the terms of the purchase agreement with the Brentford Gas Company it is proposed to pay the Directors of the former Company the enormous sum of £12,600 as compensation for loss of office—and this following the handsome sum of £500 paid to them as a *douceur* only a few months since? In my opinion, a third of the proposed sum would be too much.

Richmond, May 11, 1923. A Poor Shareholder.

The Low Carbon Monoxide Gas Discovery.

Sir,—I am gratified to see how much interest the Press is taking in our process for eliminating carbon monoxide from gas; but I am anxious that all the credit for this discovery should not be given to me. It is the joint invention of Dr. Jaques, of Liverpool, and of Mr. J. H. West, of London, in collaboration with me. My colleague, Dr. Jaques, is responsible with Mr. West for the composition of the catalyst; and the most I can claim is that I saw its value and took the process from its birth in the laboratory, and converted it into a commercial proposition—a natural task for a chemical engineer. The gasification process which bears my name and which is used in conjunction with the new method is my invention, and the result of a life's work, the fruits of which are now being reaped, as is shown by the adoption of the Tully plants all over this country.

As regards the presence of carbon monoxide in town gas, there is a variety of opinion. Though poisonous, it is a valuable component of coal gas in that it increases the illuminating effect of the incandescent mantle. Carbon monoxide has 45 p.ct. greater intensity; though its calorific value is only about 18 p.ct. greater. Many gas engineers supply a gas of low carbon monoxide content and high calorific value, for which there is no necessity. However, if the public insist on having the carbon monoxide reduced, there is no reason from a financial point of view why it should not be done without inflicting any appreciable loss to the consumer, and with an added certainty of safety. The process is extremely simple, and once put into operation is practically self-acting and self-supporting. Further, it requires no attention. I would take this opportunity of pointing out that there is nothing new in the catalytic treatment of gas. The South Metropolitan Gas Company have been treating their gas for years past by the Carpenter-Evans process for the removal of sulphur compounds. Dr. Carpenter and his staff have probably more experience in this direction than anyone. I have asked them to give me the benefit of their research work. It would only be wasting valuable time to go over work which has already been so ably done. What is of more importance is to link up my work with theirs.

To my mind the gas industry is second in importance to the part which gas will eventually play in the industrial development of our country. We have been through a great war, which has left us in keen competition with not only old competitors throughout the world, but many new ones. We have got to regain and to extend our trade and position by making use of every item of our national resources and our scientific knowledge. This can only be done by making full use of the greatest source of energy in the world—coal. We have got

to stop the criminal waste in which we have indulged for years, even for centuries. The proposition is the simple one of gasification. We ought to gasify everything that cannot be coked, or is not worth coking, on account of the ash content of the coal. We ought to gasify slack, rubbish, and third and fourth rate coals, recovering oils and bye-products. The gas could be converted into power, from power to electricity, from electricity to other products which require high temperatures for their production. The gas could be stripped of its hydrocarbons, for the production of motor spirit. It could be treated under our process for hydrogen, for all the synthetic ammonia and other methods requiring the production of cheap hydrogen. Such processes as are needed for the hydrogenation of fats and oils, for margarines, soaps, candles, and other industries could be adapted.

The quantity of waste gas that would be available within a few years might be converted into a gas similar to natural gas, which would provide more and cheaper power than could be provided by a dozen Niagara Falls. Britain's Niagara lies in the salvage of the waste that is going on in our coalfields. Let us recover that waste, and we shall have at our very doors energies that will enable us to beat the world in cheap power production.

I venture to say that neither commerce nor science will deny the enormous possibilities of a cheap source of hydrogen as the starting point for most synthetic processes.

C. B. TULLY.

Carlton on-Trent, Notts., May 8, 1923.

Non-Poisonous Gas.

SIR,—With reference to the interview with Mr. C. B. Tully, of Newark-on-Trent, who states that he has been working on a process for removing carbon monoxide from town gas, we think it necessary to point out the following facts.

In April, 1922, an agreement was entered into between Messrs. Suzuki & Co., of 29, Mincing Lane, E.C., Messrs. Tully Gas Plants, Ltd., and ourselves, to develop an invention of ours for the production from coal of gases rich in hydrogen, chiefly with a view to the manufacture of synthetic ammonia; the two firms sharing the expense. One stage of our process involves the well-known conversion of carbon monoxide and steam into carbon dioxide and hydrogen by means of a catalyst; and arrangements were made for us to work out our process at Messrs. Tully's works at Newark.

After a few months' work we evolved a very satisfactory catalyst, and succeeded, on a laboratory scale, in reducing the carbon monoxide in Newark town gas to 2 p.ct. Large-scale experiments were then begun, and these are not yet completed. Under the agreement referred to above, in exchange for the right to use Mr. Tully's patented gasification plant for our hydrogen process, we have granted to Messrs. Tully Gas Plants, Ltd., the right to use our invention when applied to town gas; and we therefore informed Mr. Tully of our results, and pointed out to him some nine months ago their bearing on the removal of carbon monoxide from town gas.

In the experiments made by Mr. Tully on a scale of about 200 c.ft. of gas per hour, the catalyst was made according to our formula, but prepared in pieces of a different form, which offers less resistance to the passage of the gas through it. The catalyst prepared in this way, being much less active than our form, is not so suitable for our purpose, though it may be satisfactory for the treatment of town gas.

J. H. WEST.
A. JAQUES.

33, Inverness Terrace, London, W 2, May 11, 1923

REGISTER OF PATENTS.

Coke Cooling.—No. 183,113.

GELSENKIRCHENER BERGWERKS-AKT, of Gelsenkirchen.

No. 15,720; June 6, 1922. Convention date, July 10, 1921.

The invention relates to a process and apparatus for cooling coke by gaseous cooling agents, and it is particularly intended to provide means for improving the quality of the products of coke-ovens.

The patentees point out that it is possible to charge the coke into chambers of oven shape, and to connect these with the admission ports of the cooling fluid. The necessity of effecting the connections with each charge, however, renders the practical application of the process exceedingly difficult. In accordance with another suggestion, the coke is charged into a container from which it is transferred into upright boilers, the heating tubs of which is sufficiently large for the reception of a charge. It possesses the inconvenience that the coke is first charged into a container, and then transferred into the cooling chamber proper. This entails an unavoidable heavy oxidation, and produces a great amount of waste in the transferring of the material.

The same inconvenience, and even to a greater extent, is unavoidable in another process, in which the coke is caused to move through a cooling pit. Another suggestion may be mentioned according to which the coke is charged into a container from which it is transferred to tiltable tub-cars, which are introduced into a closed chamber adapted to be connected with a cool gas conduit and with steam-boilers. This process involves the disadvantage of a double handling of the coke; and the necessity of effecting the gas connection with the tub-cars containing the hot coke requires great skill on the part of the operators.

This invention is intended to obviate the difficulties referred to and to provide positive means for passing cooling gases through the mass of the coke which, according to the invention, does not require to be transferred until it is cooled; no movable gas connection being necessary.

The following main claim is made:

A process of cooling coke by gaseous cooling agents characterized by charging the coke, after discharge from the coke-oven, into a receiver, and inserting this receiver, through which gas can pass, in a cooling chamber, which is fitted with fixed gas admission and discharging means.

Rotary Valves.—No. 194,267.

HUGUENIN, A., and GAGG, A., both of Zürich.

No. 2189; Jan. 24, 1923. Convention Date, Feb. 28, 1922.

Rotary valve for pipe lines are known which are provided with a closing disc having a packing face; the closing disc being pressed against a packing face arranged in the valve casing by the pressure in the pipe line. With valves of this type a perfect packing is attained, as the packing disc, owing to its movability, is enabled to adjust itself when resting on the corresponding packing face of the casing. However, they present the disadvantage that the total pressure acting upon the closing disc (which pressure may be very considerable) acts on the co-operating packing faces, whereby a displacement of these faces relatively to each other when opening or closing the valve is rendered difficult.

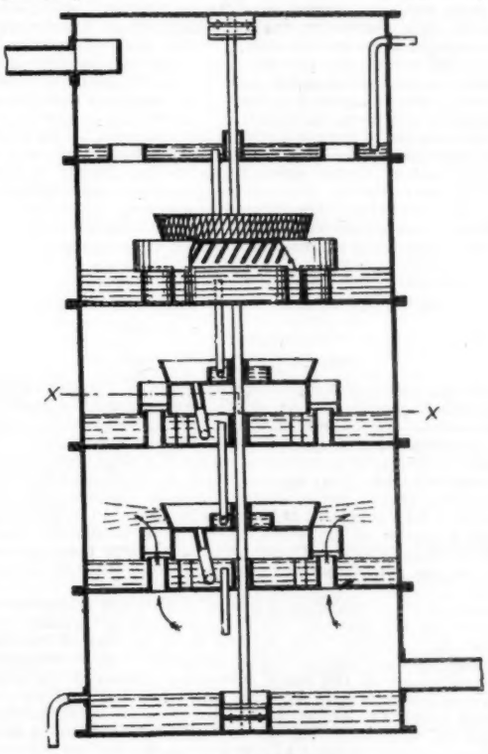
With the rotary valve according to this invention, this disadvantage is overcome by arranging a hollow space provided with a heavily-throttled supply for the medium under pressure, and with a comparatively large discharge pipe in front of the closing disc, so that the latter may totally or partially be relieved of the pressure present inside the pipe line by opening the discharge pipe. Thereby it is attained that, with an open discharge pipe, the pressure acting otherwise on the closing disc is wholly or partially taken up by the fulcrum pins of the rotary gate body. As these pins may easily be lubricated in contradistinction to the packing faces, an efficient lubrication of which is scarcely possible, and as the radius of the cylindrical gliding faces of the pins is much smaller than that of the packing faces, the work of friction when opening or closing the valve is substantially smaller. In order to actuate the rotary valve, a much smaller force has to be exerted than is the case with the hitherto known valves of this type. A further advantage consists in the fact that, owing to the absence of high pressures when the valve is opened or closed, the packing faces are subjected to a smaller wear; and the danger of the destruction of the packing faces existing with high-pressure pipe lines is overcome.

Washers or Scrubbers.—No. 194,520.

HANSFORD, J. B., of Bedford.

No. 4971; Feb. 20, 1922.

This invention relates to the type of apparatus for washing or scrubbing gas or air with liquid wherein the gas or air to be treated flows from an inlet to an outlet in a chamber containing a number of transverse partitions forming a series of superposed compartments in each of which is a revolving tray. According to the invention, the velocity of the flow of gas through the apparatus is utilized to revolve the shaft carrying the trays.



Hansford's Scrubber.

Referring to the vertical sectional elevation which we reproduce, it will be seen that a shaft extends through the compartments and is supported on ball bearings. In one or more of the compartments, and fixed in any suitable manner to the shaft, one or more annular trays are arranged. The trays have upstanding sides, in which are provided a number of notches or other apertures, or are made of perforated plate which may be fitted with nozzle pieces. Alternatively, instead of there being only a single tray in a compartment as illustrated, there may be a series of trays. Each tray, in the case where a compartment contains a single tray (or where there is a number of trays in a compartment, the lowermost tray) is provided on its underside with a number

of depending vanes on which the gas or air admitted to the chamber by means of the conduit at the bottom impinges. The velocity of the flowing gas or air on the vanes is arranged to be normally sufficient to cause the shaft, together with the trays, to revolve.

Water or other liquid may be supplied in any convenient manner to the uppermost compartment, from which it descends from compartment to compartment by means of ducts which have their outlet ends directed reversely to the direction of rotation of the trays, so that a downward suctional action occurs in them. When there is a set of trays in a compartment, the outlet from the compartment or trough immediately above the set of trays may be arranged to discharge the liquid into the uppermost tray of the set of trays in the compartment next below, the liquid overflowing therefrom into the trays below; and to facilitate the distribution of the liquid, the trays constituting a set in a compartment may decrease in size upwardly.

The liquid in the trays will, under centrifugal action, be whirled and sprayed laterally through the apertures or nozzles in the sides of the trays and into intimate contact with the upwardly flowing gas or air, which is thereby washed and cooled.

Suitable means may be provided for scooping-up liquid from a stationary trough into a tray revolving immediately above the trough, thereby circulating and concentrating the liquid.

Regulating Valves for Liquids.—No. 194,606.

Broadhead, J. B., and Wood, T., both of Brighouse.

No. 16,148; June 10, 1922.

This invention refers to that type of valve, for regulating the flow of fluids or liquids, in which a hollow valve member slides within a cylindrical member, supported within an outer casing in such a manner that an annular space or passage is left around the cylindrical member; the flow being regulated by longitudinal movement of the hollow valve member in its supporting member. The object is to provide improved means for operating the movable hollow valve member, and for balancing the pressure on the latter, so as to permit of its being easily moved.

A spindle passes through a stuffing box in the outer casing into the interior of the fixed cylindrical valve supporting member. On the inner end of this spindle is a bevel gear which meshes with a bevel gear fast on a spindle journalled in, and extending axially of, the valve supporting member. According to the invention a threaded portion on the axial spindle works in a sliding nut passing through an opening in a boss or bridge piece on the movable valve member. Rotation of the nut is prevented by a key and slot, so that rotation of the spindle causes the nut to move longitudinally in one or other direction. The nut is provided with a collar or enlargement, which in one direction of movement is adapted to engage or abut against a shoulder on the valve member and cause the latter to move in a closing direction; while a screwed collar fitting in the opening through which the nut extends is adapted to be engaged when the nut travels in the opposite direction. Such engagement moves the valve member in an opening direction. The shoulder on the valve member and the screwed collar just referred to are such a distance apart that the nut is capable of a certain amount of movement in either direction without moving the valve member. The forward end of the nut carries a valve stopper, which is adapted, under appropriate operation, to seat itself upon a seating on the inner end of a hollow thimble screwed into the conical end of the valve member; the end of the thimble having openings communicating with the bore of the valve. The forward or inlet end of the fixed or valve supporting member has an opening to admit pressure to the interior of the valve supporting member and movable valve member.

Sulphate of Ammonia Manufacture.—No. 194,625.

Douglas, R. P., of Bolton.

No. 22,347; Aug. 17, 1922.

In the manufacture of sulphate of ammonia from ammoniacal liquor by methods in which the ammonia is distilled from the liquor, steam is admitted to, or generated in, the still not only to heat the liquor but also to sweep forward the liberated ammonia and convey it to the saturator. In the latter operation the use of a large quantity of steam is usually required. This is an objection, as the steam has afterwards to be condensed and forms, with a portion of the foul gases, what is known as "devil liquor." It has been suggested to substitute air in place of a portion of this steam, the air being introduced by passing the steam through an air injector prior to entering the still, with the result that less devil liquor is formed and many other advantages are gained.

The object of this invention is to employ air-borne ammonia, tapped from the fixed still, and with the steam removed, to neutralize the acid sulphate of ammonia; this process being so carried out that no obnoxious gases are liberated where undesired. The invention consists in a modification of the above whereby a portion of the vapour is withdrawn from the fixed still, the steam removed, and the air and ammonia which was left led to any vessel or container holding the sulphate of ammonia. The air and ammonia pass along a closed circuit, are brought through a dryer and neutralizer, and the distribution of the pressure along the circuit is such that the foul gases emitted where the dry sulphate is removed are liberated only in very small quantities or not at all.

A portion of the vapours, which consist of steam, air, and ammonia, are removed from the fixed still. They are then passed through a reflux condenser. The air and ammonia are then passed forward and conducted to any vessel holding acid ammonium sulphate, where the desired neutralization may take place. It is preferable to convey the air and ammonia to a neutralizer and drier, which consists of a closed vessel into which the wet acid sulphate is fed. The opening through which the dry sulphate is removed is formed at the end of the vessel. Above this opening is the duct through which the air borne ammonia is introduced. The latter is drawn into the vessel, where part of the ammonia is absorbed, and the air, now carrying less ammonia, is urged forward to the injector. At this point the circuit is closed. By this arrangement of the pressures along the circuit, there is no tendency to leakage of gases at the point where the dry sulphate is extracted or at any point. If desired, a small quantity of steam may be allowed to pass with the air and ammonia into the drying and neutralizing vessel.

APPLICATIONS FOR PATENTS.

[Extracted from the "Official Journal" for May 9.]

Nos. 11,534 to 12,173.

Becker, J.—"Coking retort ovens." No. 11,602.
Coke and Gas Ovens, Ltd.—"Preparation of pitch." No. 12,094.
Cummins, F. B.—"Vertical retort settings." No. 12,027.
Fairweather, W. C.—"Regulating device for gas supply to apparatus." No. 12,035.
Fregn, Brassert, and Co.—"Overflow drain and water seal for gas-washers." No. 11,649.
Harsant, H.—"Gas generating plant." No. 12,083.
Hobbs, H. T.—"Prevention of down-draught in gas flues, &c." No. 11,751.
Keillor, G.—"Combined gas-cooker and hot-water circulator." No. 11,945.
Lewis, G. M.—"Incandescent gas-burners." No. 12,030.
M'Dowell, F.—See Harsant, H. No. 12,083.
M'Gibbon, J. S.—"Attachment to gas taps." No. 11,696.
M'Loughlin, P.—"Globe fasteners for gas-burners." No. 12,026.
Malone, J. F. J.—"Gas density indication." No. 11,921.
Minaux, P.—"Lighting and extinguishing gas-burners." No. 11 880.
Naamlooze Vennootschap Bureau voorheen Nell & Stutterheim.—See Fairweather, W. C. No. 12,035.
Radiation, Ltd.—"Atmospheric burners." No. 11 560.
Radiation, Ltd.—"Water-boiling apparatus." No. 11 641.
Raybould, A.—See Lewis, G. M. No. 12,030.
Sherburn, W. H.—See Radiation, Ltd. No. 11,560.
Simpson, J.—See Keillor, G. No. 11,945.
Slack, J. W.—See Radiation, Ltd. No. 11,560.
Smith, N. S.—See Keillor, G. No. 11,945.
South Metropolitan Gas Company.—"Taps and cocks." No. 11 972.
Tully, C. B.—"Treatment of gas." No. 12,088.
Wright, J. C.—"Gas washers or purifiers." No. 11,797.
Yates, H. J.—See Radiation, Ltd. No. 11,641.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS.

Progress of Bills.

South Elmsall and District Gas Bill: Reported, with amendments.

HOUSE OF COMMONS.

Progress of Bills.

Oakham Gas and Electricity Bill: Standing Orders not previously inquired into complied with; to be read a second time.

Smethwick Corporation (Gas) Bill: Read a second time, and committed.

Public Utility Companies (Capital Issues) Act.

A copy was presented of a report by the Board of Trade under the Act on an application by the Dunstable Gas and Water Company.

Industrial Workers—Conditions and Production.

Sir W. Sugden asked the Home Secretary for information as to the relative productiveness under specified different forms of electric lighting and gas lighting in this country; and any statistics bearing upon the eyesight of the workers in such specified industries and lights.

Mr. Bridgeman said that practically all the information at present available as to the effects of lighting on the output and health of the industrial worker was to be found in the Reports of the Departmental Committee on Factory Lighting.

Standard Price Revision.

Mr. Ede asked the President of the Board of Trade if he had yet replied to the letter received on Jan. 25 last from the Mitcham Urban District Council asking for an inquiry into the standard price of gas; if he had framed rules governing the procedure in regard to applications of this nature under the Gas Regulation Act, 1920; and, if not, when they would be?

Viscount Wolmer replied that rules had been made, and were laid on the Table on April 18. The Board of Trade sent a copy of them to the Urban District Council on April 25.

SOUTH ELMSALL AND DISTRICT GAS BILL.

This Bill came before the Unopposed Committee of the House of Lords, presided over by the Lord Chairman, the Earl of Donoughmore, on Tuesday, May 1, and was ordered to await report, with amendments. [See "Journal," Feb. 14, p. 386.]

Among the additional clauses to the Bill is one which provides that if, after the expiration of five years from the passing of the Act, the

Company have not laid down mains for the supply of gas in the areas to be added to the present limits of supply, the local authority, or any company or person, may apply for an Act of Parliament or special Order for the purpose of providing such a supply, and for the repeal of the powers of the Company.

The provisions with regard to dividends have been amended; and it is now provided that the maximum dividends on £7540 of the original capital (£30,000) shall be 10 p.ct., and on the remaining £22,460, 8 p.ct. On the additional capital (£20,000), the rate remains as originally deposited, viz.—8 p.ct. on that issued as ordinary, and 7 p.ct. on that issued as preference.

A number of clauses have also been added for the protection of the West Riding County Council, the Hemsworth Rural District Council, the Doncaster Rural District Council, and railway companies.

With regard to the price of gas, the proposed 15·4d. per therm, which was originally the standard price, is now the maximum, and the sliding-scale is dispensed with. An addition provides that, for the purpose of any revision, under section I. of the Gas Regulation Act, 1920, or any amendment thereof, of the maximum price prescribed, such price shall be deemed to have been fixed by the Board of Trade on Aug. 8, 1922, by Order under section I. of the above Act. It is also provided that at any time after the expiration of two years from the passing of this Act, the Board of Trade may fix a standard price in respect of the gas supplied by the Company, and, as from the date specified in the Board of Trade Order, the provisions contained in a schedule to the Act are to come into operation. This schedule provides that the price shall be a standard instead of the maximum price, and the sliding-scale shall operate. Power is also included in the schedule to create a special purposes fund out of the revenue to the extent of 1 p.ct. of the paid-up capital in any year; and the maximum amount of the fund must not at any time exceed one-tenth part of the paid-up capital. There is also power to create a reserve fund out of the divisible profits in the event of the dividends payable on ordinary capital exceeding the standard rates.

The provisions with regard to the price of gas to the Rural District Council of Hemsworth for public lighting and other purposes within the limits of supply, are also to apply to the Rural District Council of Doncaster. As to gas supplied through prepayment meters to the occupier of a dwelling house belonging to, or provided by, the Rural District Councils of Hemsworth and Doncaster, in which the necessary fittings have been provided and fixed by the Council, the charge must not exceed, in addition to the charge for gas supplied, 2·5d. per therm, in consideration of which payment the Company shall repair such meters and fittings.

MAIDSTONE CORPORATION BILL.

In this Bill, which has been under consideration by a Committee of the House of Lords recently, power is sought by the Maidstone Corporation to provide trolley vehicles. In a clause dealing with electrical works, power is included, subject to the provisions of the Bill or of any enactment incorporated therewith, to open and break up streets or roads.

A clause for the protection of the Maidstone Gas Company has been included in the Bill, as follows:

> For the protection of the Maidstone Gas Company (in this section referred to as "the Company") the following provisions shall, unless otherwise agreed in writing between the Company and the Corporation, have effect—that is to say—
>
> (1) If the Corporation, under the powers of this part of this Act, shall erect any pole, shed, shelter, waiting room, or cloak room over any main pipe, service pipe, work, or apparatus of the Company (all of which are in this section included in the expression "apparatus"), or so near to any such apparatus as to cause risk of injury thereto or to obstruct access by the Company to any such apparatus, the Company may carry out such work as may be reasonably necessary for preventing any such injury, or for enabling them to obtain access to such apparatus, and the Corporation shall, on demand, repay to the Company the cost reasonably incurred by them in so doing.
>
> (2) If any difference shall arise between the Corporation and the Company under the provisions of this section, the matter in difference shall be referred to and settled by an arbitrator to be agreed upon by the parties, or (failing such agreement) to be appointed on the application of either party, after notice in writing to the other, by the President of the Institution of Civil Engineers, and, subject as aforesaid, the Arbitration Act, 1889, shall apply to any such reference to arbitration.

BARNSLEY CORPORATION BILL.

This Bill was considered by the Local Legislation Committee of the House of Commons—presided over by Sir Thomas Robinson—on Tuesday, May 8. As explained in the "JOURNAL" (Feb. 14, p. 385), the Corporation seek power to acquire part of the private railway siding of the Barnsley Gas Company, and a small area of land near, for the benefit of their adjoining electricity works. Originally the Gas Company opposed the Bill in regard to this matter, but the petition was subsequently withdrawn.

Mr. E. A. BARKER (Electrical Engineer, Barnsley), giving evidence, explained to the Committee that the Corporation are now entering into an agreement with the Gas Company in regard to the sidings. The Gas Company, however, retained their power to oppose the Bill, if they thought fit, in the House of Lords.

The clause was, therefore, allowed to stand.

LEGAL INTELLIGENCE.

Theft of Coke.

A fine of £5 was imposed at the Poole Police Court last Thursday on William Walter Blake, formerly employed by the Bournemouth Gas and Water Company, for stealing coke to the value of 14s., the property of the Company. Frank Cake, a cycle repairer, of Parkstone, was similarly fined on a charge of receiving the stolen coke. The Magistrates were informed that a "leakage" from the coke store was suspected, and that on a particular occasion observation was kept, and Cake was seen to hand something, presumably money, to Blake. It was stated that the Company did not wish to press the case against Blake, who had lost his situation after ten years' employment, with which had gone his chance of a pension.

A Sale of Gas-Mantles.

A dispute concerning the purchase of some gas-mantles occupied the attention of his Honour Judge Amphlett, K.C., at the Birmingham County Court last Thursday. The Oriental and General Trading Company, of Grosvenor Buildings, Crescent Road, Harrogate, sought to recover £55 for 50 gross of gas-mantles, at 22s. per gross, and 11s. for cases, from the Wholesale Mantles and Hardware Supply Company, No. 457, Moseley Road, Birmingham. It was stated that the defendants placed an order for 50 gross of mantles with the plaintiffs' agent. The defendants had refused to pay for the goods, which were supplied as "seconds."—William Tyler, agent for the plaintiffs, said he took the order from the defendants. The mantles were good and merchantable articles. Defendants complained that they were not good, and witness went to inspect them. He saw some in cases exposed to the weather outside the premises.—John William Lowe, trading as the Wholesale Mantles and Hardware Company, said he ordered a gross of "seconds" mantles as a sample; and the order for 50 gross was based on the quality of this sample. The 50 gross did not come up to the quality of the sample. Witness wrote to the plaintiffs to this effect; and Tyler called and admitted there was a difference in the quality of the mantles, and said he would try to sell them.—Judge Amphlett, in giving judgment for the plaintiffs, with costs, said he did not think this was a sale by sample upon which the defendants relied. The goods delivered were of merchantable quality.

The Life of a Gas-Stove.—Underwriters' Liability.

In the Mayor's and City of London Court, last Thursday, Mr. Ralph W. H. Gillett, of Lincoln House, High Holborn, claimed £9 6s. 6d. against Mr. E. F. de Rougemont, Mr. J. D. Choisy, Mr. A F. de Rougemont and Mr. D. R. Bellamy, all underwriters at Lloyd's, under a policy of insurance of April, 1920, whereby plaintiff was indemnified against loss by explosion. An explosion occurred on plaintiff's premises, resulting in the complete destruction of his gas-cooker. He now claimed the cost of renewing it. Mr. Ellis appeared for the plaintiff, and Mr. Berryman for the defendants. Plaintiff's case was that in September, 1919, the Gas Light and Coke Company, who had hired the stove out to him, sold it to him under a special scheme for four guineas. The value was really £10 6s. 9d. When his cooker was destroyed he bought another for £13 7s. 6d., and now claimed £9 0s. 6d. as the value of the old stove at the time of the explosion.—Defendants said that four guineas was all the plaintiff was entitled to, as that was what he paid for the stove.—Mr. F. W. Goodenough (Sales Manager to the Gas Light and Coke Company) said that in February, 1919, owing to a rise in the cost of repairs, it was found necessary to increase rents by 50 p.ct. Plaintiff took advantage of the offer to buy the stove in February, 1920. At the time of the accident the price of a second-hand stove of a similar pattern to the one in dispute would have been £9 0s. 6d. The life of a gas-cooker, if repaired from time to time according to the necessities of the case, was indefinite.—Judge Shewell Cooper: Then our grandchildren may still be employing the stoves which we are using?—Witness said there were stoves which had been in use for fifty years.—Judge Shewell Cooper said that of course there had been an extraordinary increase in the value of things in recent years. The four guineas which the defendants had paid into Court was not enough. He thought a fair value was seven guineas, and found for the plaintiff for this amount, with costs.

Cape Town and District Gas Light and Coke Company, Ltd.—At the meeting of shareholders to-day (Wednesday), when the accounts for the year ended Dec. 31 will be submitted, the Directors will report that the balance at credit of revenue account is £22,034. Adding profit on sale of investments and the sum brought forward makes a total amount of £28,131. The Directors recommend the payment of a final dividend on the ordinary shares of 3½ p.ct., making with the interim dividend 7 p.ct. for the year, and leaving £3421 to be carried forward. Though the sale of gas decreased by 3·89 p.ct., sales were maintained, there being a slight increase of 0·65 p.ct., showing that the special attention given to the matter of leakage had good effect. Vertical retort installation No. 2 was put to work in December last. It is with the deepest regret that the Directors report the death of the late Chairman, Mr. J. E. Lilley. The Company have had the advantage of his unremitting attention to every aspect of their affairs for nearly 27 years; and the Board place on record their appreciation of those services, and their sorrow at the loss of his co-operation. Mr. H. R. Savory, formerly Vice-Chairman, has been appointed Chairman. The vacancy on the Board has been filled by the election as a Director of Mr. R. W. Blackburn, who has been associated with the Company for the past 25 years. The Directors were glad to mark by this appointment their sense of his intimate knowledge of, and attention to, the Company's business. For the present, Mr. Blackburn will continue also to discharge the duties of Secretary.

MISCELLANEOUS NEWS.

GAS REGULATION ACT APPLICATIONS.

The following further notices have appeared in the "London Gazette" with regard to applications to the Board of Trade for Orders under the Gas Regulation Act.

Doncaster Corporation.

The maximum price now authorized in respect of the supply of gas by the undertakers is 3s. 6d. per 1000 c.ft.; and the price they have asked the Board of Trade to substitute for this is 1s. 1·5d. per therm.

Market Harborough Urban District Council.

The maximum price now authorized in respect of the supply of gas by the undertakers is 3s. 6d. per 1000 c.ft.; and the price they have asked the Board of Trade to substitute for this is 1s. 2d. per therm.

Petersfield and Selsey Gas Company.

The standard price now authorized in respect of the supply of gas by the undertakers within the urban district of Petersfield and the parishes of Steep and Buriton is 4s., and in other parishes within the limits of supply 5s. per 1000 c.ft.; and the prices which they have asked the Board of Trade to substitute for these are 1s. 9d. and 2s. per therm respectively.

It is also proposed that an additional charge of 2d. per therm should be authorized in respect of gas supplied through a prepayment meter.

The undertakers are the owners of two gas-works, one situate at Petersfield, and the other at Selsey. In Petersfield and district the standard price is 4s., and at Selsey 5s. per 1000 c.ft.

Rainhill Gas and Water Company.

The maximum price now authorized in respect of the supply of gas by the undertakers is 4s. 6d. per 1000 c.ft.; and the price they have asked the Board of Trade to substitute for this is 1s. 6d. per therm.

Rothwell Gas Light Company.

The maximum price now authorized in respect of the supply of gas by the undertakers is 5s. per 1000 c.ft.; and the price they have asked the Board of Trade to substitute for this is 1s. 3d. per therm.

Skipton Urban District Council.

The maximum price now authorized in respect of the supply of gas by the undertakers is 3s. 6d. per 1000 c.ft.; and the price they have asked the Board of Trade to substitute for this is 13d. per therm.

County Borough of Wigan.

The maximum price now authorized in respect of the supply of gas by the undertakers is 4s. 2d. per 1000 c.ft. in the borough or within a circle the radius of which would be one mile in distance from the present gasholder at the works, and 5s. 6d. outside; and the prices which they have asked the Board of Trade to substitute for these are 12·63d. and 13·9d. per therm respectively.

It is also proposed that an additional charge of 1d. per therm should be authorized in respect of gas supplied through a prepayment meter.

It is further proposed that the minimum permissible pressure to be provided for by the Order shall be (instead of that prescribed in section 2 of the Gas Regulation Act, 1920) such a pressure as to balance a column of water not less than 15-10ths of an inch in height in any main having an internal diameter of 2 in. or upwards and as near as may be to the junction therewith of the service-pipes supplying the consumer.

SPECIAL ORDER.

Derby Gas Light and Coke Company.

The Company give notice of their intention to apply to the Board of Trade for a Special Order under section 10 to authorize them to use for gas-works purposes land scheduled, to carry into effect agreements with the Mayor, Aldermen, and Burgesses with respect to the prices to be charged for gas, and to regulate the supply of gas, &c.

GAS REGULATION ACT ORDERS.

The Director of Gas Administration has forwarded copies of the following further Orders made by the Board of Trade under section 1 of the Gas Regulation Act.

Builth Gas and Coke Company, Ltd.

After the declared date, the maximum prices in respect of gas supplied by the undertakers shall be 17 6d. per therm; and this price shall be substituted for the price of 5s. 6d. per 1000 c.ft. whenever it is mentioned in section 19 (price of gas) of the Builth Wells Gas Order, 1910.

After the declared date, the word "therm" shall be substituted for "1000 c.ft." in paragraph (2) of Schedule B to the Builth Wells Gas Order, 1910; and the words "fifth of a penny" shall be substituted for the word "penny" whenever it occurs in that paragraph. (May 7.)

Ripon Corporation.

After the declared date, the maximum price in respect of gas supplied by the undertakers shall be 17d. per therm.

After the declared date, the price of 14 6d. per therm shall be substituted for the price of 4s. 6d. per 1000 c.ft. mentioned in Article XII. of the Ripon Order, 1898. (May 4)

Sedbergh New Gas Company, Ltd.

After the declared date, the maximum price in respect of gas supplied by the undertakers shall be 19d. per therm; and this price shall be substituted for the price of 5s. 10d. per 1000 c.ft. where it is mentioned in section 26 (price of gas) of the Sedbergh Gas Order, 1897.

After the declared date, the word "therm" shall be substituted for "1000 c.ft." in paragraph (ii.) of Schedule B to the Sedbergh Gas Order, 1897, and the words "fifth of a penny" shall be substituted for "penny" wherever it occurs in that paragraph. (May 4.)

Stockton-on-Tees Corporation.

After the declared date, the maximum prices in respect of gas supplied by the undertakers shall be 14d. and 16d. per therm; and these prices respectively shall be substituted for the prices of 5s. and 6s. per 1000 c.ft. mentioned in section LXXVII. of the Stockton Gas Act, 1857. (May 9.)

Todmorden Corporation.

After the declared date, the maximum price in respect of gas supplied by the undertakers shall be 17d. per therm. (May 7.)

IMPERIAL CONTINENTAL GAS ASSOCIATION.

Annual Report of the Directors.

The following is the report for the year ended Dec. 31 last, which will be submitted to the proprietors at the meeting on May 30:

The profit for the year amounted to £146,343, which, together with the sum of £19 998 15s. 1d. brought forward from the previous year's account, makes a total of £166 341 15s. 1d. available for appropriation, out of which an interim dividend of 5 p.ct., less tax, amounting to £72 865 8s. 11d. was paid in November last. The Directors now recommend that, in addition to the above interim dividend, a final ordinary dividend be declared at the rate of 5 p.ct. actual, less income-tax at 5s. 3d. in the pound (being the average rate for the year), to be paid on June 15, 1923, making the total dividend for the year 10 p.ct., and leaving £20,610 17s. 3d. to be carried forward to the next account.

Of the agreed compromise of £1,600,000 in respect of the Association's German claims, the sum of £49,750 net was remitted by the Clearing Office on Feb. 28, 1922, being the German Liquidator's charges refunded to the Association, and a payment, on account of the balance of the compromise, amounting to £188 948 18s. 1d. net, was remitted on Jan. 15, 1923, making a combined total sum of £238,698 18s. 1d. The Directors recommend that this sum of £238,698 18s. 1d., being a realized accretion to capital, be dealt with as profit, and applied in payment of a special dividend for the year 1922 at the rate of 12 p.ct. per annum on the nominal amount of the issued capital stock of the association, payable on the same date as the final ordinary dividend—*i.e.*, on June 15, 1923.

The total output of gas in the towns supplied by the Association in 1922 was 4911 million c.ft., showing an increase at the rate of 4 p.ct. on the preceding year. The number of consumers on Dec. 31 last was 235,814, and shows an increase at the rate of 2·24 p.ct. in the year. During the year, 13 miles of new mains were laid, principally at Antwerp and Brussels; but this was counterbalanced by the surrender on July 1 of the mains at the small Czecho-Slovakian station of Saaz, which was sold to the local municipal authorities. The length of mains on Dec. 31 last was 1337 miles. The quantity of coal carbonized during the year under review was 297,080 metric tons, at an average gross cost per ton delivered on to the works of 28s. 11d., or 9s. 10d. per ton less than in the preceding year. The Droogenbosch electricity works at Brussels sold, during 1922, 11,995,096 units, as compared 7,322,893 units in 1921, an increase of 4,672,203 units, or 63·8 p.ct.

At Antwerp contracts were signed with the Communes of Waerlcos (1100 inhabitants) and Pulderbosch (900 inhabitants) for the supply of gas until 1954. At Brussels prolongations of contract were secured at Droogenbosch (2100 inhabitants) for gas and electricity until 1954, Etterbeek (40,700 inhabitants) for gas and electricity until 1950, and Molenbeek (67,200 inhabitants) for gas until 1937. A contract for the supply of gas and electricity was also concluded with the Commune of Itterbeek (1100 inhabitants) until 1951.

At Antwerp good progress was made with the erection of the new retort-house and vertical furnaces on the Hoboken works. At Brussels three houses adjoining the Association's existing offices in the Chaussée d'Ixelles were purchased, with a view to providing much-needed additional office accommodation. The erection of a waste-heat boiler for the water-gas plant, and the re-setting of the vertical retorts on the Forest works, were completed. At the Koekelberg works the reconstruction of a number of the retort-benches was finished.

The deepened canal between Antwerp and Brussels was opened in November last; and it is now possible for the Association to send steamers carrying 3000 tons of coal direct from the United Kingdom to Brussels. At the Droogenbosch electricity works progress was made with the extension of the engine and boiler-house, and with the foundations for six additional Babcock and Wilcox boilers, and for an additional 10,000 KW. turbo-alternator. The new coal-handling plant was put into action.

The Directors who go out of office by rotation are Mr. Robert William Wilson, the Right Hon. Sir Guy Douglas Arthur Fleetwood Wilson, G.C.I.E., K.C.B., K.C.M.G., and Mr. Harold Godfrey Palmer.

These gentlemen are eligible for re-election, and offer themselves accordingly. The Auditor who goes out of office is Mr. Chapman Frederick Dendy Marshall, M.A., who is eligible for re-election, and offers himself accordingly.

(Signed) C. J. Jèssel,
Chairman.

Last week, Messrs. A. & W. Richards, of No. 37, Walbrook, E.C., were instructed by the Directors to issue £10,000 of 6 p.ct. redeemable debenture stock in the Crowborough District Gas Company. The issue price was par. Under an Act obtained in 1913, the Company are authorized to supply electricity; and the capital raised will be utilized in payment for the electrical installation. The issue offered was nearly twice subscribed.

THE BRENTFORD AMALGAMATION SCHEMES.

An Extraordinary Meeting of proprietors of the Brentford Gas Company will be held at Caxton Hall, Westminster, on Friday, May 25, at 2.30, to consider the draft of a Special Order for which application is proposed to be made by the Company to the Board of Trade under section 10 of the Gas Regulation Act, authorizing the acquisition by the Company of the undertakings of the Harrow and Stanmore Gas Company and the Richmond Gas Company, and for other purposes. The provisional agreements entered into with the Companies provide for the issue to holders of ordinary and preference stock and debenture stock of those Companies of ordinary, preference, or debenture stock of the Brentford Gas Company. The terms proposed in the case of the Harrow and Stanmore Gas Company will be found in the "JOURNAL" for May 9, p. 365. For the Richmond Company's stocks, the proposal is to give:

(*a*) For each £100 of ordinary stock of the Richmond Gas Company, £100 of 6 p.ct. debenture stock of the Brentford Gas Company redeemable at 106 p.ct. on Jan. 1 and July 1 in any year on six months' notice by the Company.

(*b*) For each £100 of 5 p.ct. debenture stock of the Richmond Gas Company, £125 of 4 p.ct. debenture stock of the Brentford Gas Company.

The Directors of the Brentford Company, in recommending these amalgamations to the proprietors with every confidence, say:

The undertaking of the Harrow and Stanmore Gas Company is in a very sound condition, and is rapidly extending; and as the railway facilities are exceptionally good, there is every prospect of the sale of gas in the area increasing in the future even more rapidly than in the past. The district contains a great deal of land in course of development; and development—largely industrial—is taking place most rapidly in an area intersected by the irregular and intricate boundary between the areas of the Harrow and Brentford Companies, which renders an efficient supply of gas difficult and costly to both. If the whole of this area is placed under the control of a single company, important economies will be effected, and better service given to consumers.

The Richmond Gas Company's area originally formed a portion of the Brentford District, and is a well-known residential neighbourhood. The works will be found of great use in improving the supply of gas to the Brentford Company's existing area south of the Thames.

STAFFORD GAS-WORKS REPORT.

Record Gross and Net Profits.

It is stated by Mr. T. H. Poulson, the Engineer and Manager, in his annual report to the Stafford Corporation Gas Committee, that the quantity of gas made in the twelve months ended March 31 was 309,820,000 c.ft., as against 317,239,755 c.ft. in the preceding year—a decrease of 2·33 p.ct.

The gas accounted for amounted to 297,118,000 c.ft., compared with 303 879,755 c.ft. a year ago, being a decrease of 2·22 p.ct. This left 12,702,000 c.ft. unaccounted for, or 4·1 p.ct., as compared with 4·21 p.ct. in the previous year. Of the total gas sold, quarterly consumers accounted for 166.773.000 c ft.—a decrease of 2·51 p.ct. The gas supplied to power consumers is included under this heading, and amounted to 62,971,000 c.ft., as against 59.000,000 c.ft. in the previous year. Prepayment consumers took 110,524,000 c.ft.—a decrease of 2·49 p.ct.

During the year 17,377 tons of coal were carbonized, resulting in a make per ton of 17,229 c.ft., compared with 17,265 c.ft. the year before. This slight decrease was more than counterbalanced by the higher quality of the gas produced. The cost of coal throughout the year averaged 30s. 6d. per ton, as compared with 47s. per ton; or 21·419d. per 1000 c.ft., against 34·096d. Receipts for residuals totalled 10·633d. per 1000 c.ft., compared with 12·433d. The net cost of coal was 10·786d. per 1000 c.ft., against 21·663d. in the previous year.

The result of the year's working is a gross profit, as analyzed by the Borough Treasurer, of £22,659. After providing for loans repaid, interest on capital, depreciation, and income-tax, there remains a net surplus of £9394, which is £7510 more than the previous year. With £307 brought forward from the previous year, there is a total undistributed surplus of £9701, of which £2000 has been voted to the relief of the general district rate for the current year, leaving a balance of £7701. Of this £7200 has been placed to reserve.

It has been decided to make an all-round reduction of 6d. per 1000 c.ft. after the readings of the meters at the end of the current quarter. This will make the scale:

For a Quantity Exceeding per Quarter.	But not Exceeding per Quarter.	Price per 1000 C.Ft.
Cubic Feet.	Cubic Feet.	s. d.
..	20,000	3 9
20,000	100,000	3 7
100,000	200,000	3 0
200,000	1,000,000	2 10
1,000,000	2,000,000	2 9
2,000,000	3,000,000	2 7½
3,000,000	4,000,000	2 6
4,000,000	5,000,000	2 3
5,000,000	..	2 0

All prices less 5 p.ct. if account is paid within one month from quarter end.

Much satisfaction was expressed by members when the report came before the Town Council. A proposition that the price of gas should be still further reduced was rejected.

The Chorley Town Council have decided that the price of gas inside and outside the borough shall be decreased 6d. per 1000 c.ft.

BOMBAY GAS COMPANY, LTD.

The Ordinary General Meeting of the Company was held last Thursday, at the London Offices, Moorgate Station Chambers, E.C.—Mr. H. E. JONES (the Chairman) presiding,

The SECRETARY (Mr. A. Dickson, Jun.) read the notice convening the meeting and the report of the Auditors; and the Directors' report and the statement of accounts were taken as read.

A SATISFACTORY DIVIDEND.

The CHAIRMAN, in moving the adoption of the Directors' report and the accounts, said he thought they must congratulate themselves on having met that day to declare the dividend which was announced in the report, at the not altogether parsimonious rate of 8 p.ct. per annum. Such had not been the history of many companies. During the last few years, however, they had been pegging along in Bombay, and continuing to pay their dividend. Fortunately their undertaking had not been too near the scene of the disastrous war that had so frightfully upset Europe. The report told them that the profit secured this dividend. He could go through every detail of income and expenditure; but he did not propose to do this, though he would, of course, be pleased to answer any questions that might be put to him. While freight on coals had been dearer, residuals—both coke and tar—had improved, so that they were not any worse off. A glance at the figures would show that upon the whole they were good. What was very cheering was that there were great works going on in the development of Bombay. There were large shallow areas on the margin of the city, which were useless for shipping because the ships could not get near enough to the land. These areas were going to be filled in. They had with them at the meeting Mr. Lane, their Deputy-Manager, who had told him that these developments were sure to inure to the benefit not only of the city, but of the Company also. Bombay was a fine city. The representations of its buildings which his son had sent him many years ago when he was out there showed that it had considerable claim to be called beautiful. The streets were wide and straight; and many of the more modern parts were very handsomely provided. In fact, apart altogether from the question of dividend, and so forth, the Company had the privilege—which he personally was very proud of, and he was sure the other Directors and the staff were proud of it too—of being entrusted with the great duty of discharging a vital public service by supplying gas to a city which must be very near the third or fourth in the whole Empire. If they looked at the matter fairly, it was not merely a sordid question of pounds, shillings, and pence, though they must not neglect this aspect—at any rate, he should be ashamed to face the shareholders again if he did. But there was a source of great satisfaction in knowing that they were so useful to a very large community, though by far the greater proportion of the population was of the Eastern Race. He did not for one moment suggest that, because they were of the Eastern Race, the Company should be any less careful of their interests, comfort, and convenience than if they were Europeans, indeed, he thought it was rather the other way. They should take all pains to teach them what the white man could do for them in the direction of adding to their comforts and convenience. At the moment, the Company appeared to be selling not quite so much gas as they would like—not showing quite the progress that they had done in past years—but Mr. Lane told them, and their Engineer (Mr. A. R. Burch) had told them, that there was some "tightness in the chest," he meant the "money chest," of the people in Bombay. Trade out there was not very prosperous; money was tight, and there was not much to spend in luxury—and the shareholders would agree with him that gas was not only a great comfort, but a great luxury. Even in this country undertakings had not been selling gas very freely lately, for nobody had too much money. The Company had a rather expensive staff in Bombay; and a number of them, owing to climatic conditions, had to keep their wives and families in England. The Directors were going to see how far they could make use of the undoubted skill of the Indians for filling junior staff appointments. It would be not only an economy to do this, but it was a duty to make the most of what he might term their natural resources.

A NEW DIRECTOR.

The report told them that the Board had appointed Mr. Hugh Henderson Macleod to be a Director. They had under the Articles power to appoint specially an extra Director; and they had done so. Mr. Macleod had had great experience in India. He had special knowledge of coal, having been connected with a company out there which had to deal with it; and he had in England connections with mercantile matters of the first class and magnitude. Bearing all these facts in mind, he thought they had "hooked a very good fish." He remembered having used the same expression when they selected their banker member, Mr. W. G. Bradshaw. It was of great importance that the Board should be constituted of men of outstanding ability, with claims to business experience and knowledge.

POINTS FROM THE ACCOUNTS.

In connection with the works, repairs and maintenance—a matter to which he always attached great importance—were charged at £15,705, against £11,300 a year ago. This was chiefly because, as material got cheaper, they found they could afford to spend profitably in this way a little more money. In the same manner, they had maintained the distribution side at a cost of £12,900, as against £12,483 last year. A dividend was a very questionable profit or advantage if it was earned by the neglect of, or the failure to attend to, the upkeep of both manufacturing works and the distribution department. The figures quoted showed that these matters had been fully and properly looked after. Possibly he had passed over without reference many points which would be of interest to the shareholders; and if so, he would be glad to be questioned with regard to them. One shareholder living at a distance, who was unable to be present, had written asking various things. He wanted to know why they did not manufacture sulphate of ammonia. This question had been in the minds of the Directors for a long time; but they had been diverted from their intention to deal with it by two matters. In the

first place, years ago it was almost impossible to get acid; and their scale of working was so small that they could not reasonably undertake the manufacture of it themselves, as he hoped they would do before long. Another reason was that some adventurous parties leased part of the works, and began to put up some plant and gave them a price under contract for the ammonia, which would have provided a small income. They would have been glad to get something in this way and save capital outlay; but this scheme had now broken down, and they would themselves have to proceed with the matter. Then the sum of £3129 deducted from the gross revenue from coke was £1300 more than in 1921. The increase was mainly represented by wages £755, tyres for steam wagons £332, and an item of £151 paid for carriage of coke during the time the wagons were under repair. Next he wanted to know why establishment charges were increased by £979. This was necessary. They had had to furnish the new office; and food was dear, so that bonuses, &c., had to be given. He should have thought anyone would have known that establishment charges must go up during such a period as they had been passing through. Then he asked whether there was any prospect of fresh capital being required. Of course, one way of impoverishing a concern was to increase capital without increasing the business. The Company, however, had followed the other rule. They had largely increased the business, and had been able—partly owing to wise provision originally made in the works and mains—to get along without calling up further capital. He did not think this needed any excuse. They would not call up more capital if it could be avoided; but should the great developments in Bombay necessitate expenditure which could not be met out of the earnings, it would have to be done. In that case, they would seek the advice of financial experts. There was an unwillingness in this country to lend money on debentures on works not easily realizable here; but this could be got over.

The Deputy-Chairman (Mr. W. G. Bradshaw, C.B.E.) formally seconded the motion.

Mr. Samuel Spencer said that, going through the balance-sheet, he could see prosperity and progress in front of the Company. He was delighted to hear of the appointment of the new Director. The Chairman's full explanation must give satisfaction to everybody.

Mr. H. King Hiller remarked that the Chairman had not told the whole story. Something more might have been said about the receipts from residuals, which were very satisfactory. Then the sale of gas was about 13,000 c.ft. to the ton. This was an excellent return from a foreign gas-works, and was not equalled by many in England. The staff out there, as well as the Directors, should be highly complimented upon the results attained. He considered it was very gratifying to the shareholders to know that the question of the manufacture of sulphate of ammonia was to be taken up. Had the Board considered the production of ammonia for refrigerating plants out there?

The Chairman pointed out that a very pure form of ammonia was required for this purpose.

Mr. King Hiller: It is a very profitable business, though.

The report and accounts were then unanimously adopted.

Dividend and Re-elections.

On the proposition of the Chairman, it was agreed: "That a final dividend for the year ended Dec. 31, 1922, of 4 p.ct. (less income-tax at the rate of 2s. 9d. in the pound) be now declared payable on and after the 24th inst., making with the interim dividend of 4 p.ct. a dividend of 8 p.ct. for the year."

The Chairman proposed the re-election of Mr. Charles Hunt as a Director. He pointed out that Mr. Hunt had a great reputation in gas matters, and had been a tower of strength to the Board. His sound judgment was of the greatest possible assistance to them. He had already stated that Mr. Macleod had just been put on the Board; and now the shareholders had to confirm that by re-electing him. Mr. Macleod had only been to the Board meetings three or four times; but each occasion had deepened the conviction in his (the Chairman's) mind that they had the right man in the right place.

The Deputy Chairman seconded the resolution, which was unanimously agreed to, and acknowledged by Mr. Hunt and Mr. Macleod.

The Auditors (Messrs. Spencer Gore Browne and Mr. Alfred Morland, F.C.A.) were also re-appointed, on the proposition of Mr. Stanley H. Jones, seconded by Mr. H. F. Hills.

An Optimistic View.

The Chairman said he felt much indebted to Mr. Spencer for his references to the good working of the Company, because he himself had omitted to tell them what he had had it in mind to say—that the whole of the working had been very good, and bore comparison with the highest standards reached in this country. How far the climate affected matters he did not know; but it took myriads of men to do it. The Indians were slight, and incapable of very great physical effort. So well had Mr. Burch conducted their affairs ever since he went out to India—and he found when he went that things had not been carried on quite as they might have been—that unfailingly half year by half year they got from him full analyses of the working which showed that they were doing excellently in all respects. Mr. Lane was with them at the meeting, and would be very glad to let his colleagues know the handsome way in which their services had been recognized. He proposed a very hearty vote of thanks to the whole of the staff in India and also to Mr. Dickson and the clerical staff on this side.

The Deputy-Chairman seconded the vote, which was cordially passed.

Mr. W. J. Liberty remarked that they would all be pleased to have a few words from Mr. Lane.

Mr. W. T. Lane, acknowledging the vote on behalf of his Chief, Mr. Burch, and his colleagues on the staff, and the workmen in India, assured the shareholders that they all, from top to bottom, considered it a very great privilege to work for the Company. He himself had had this privilege for some 23 years. They were specially proud of being controlled by, he thought, one of the most able and kind Boards it was possible to have. To them, the Chairman was the greatest gas engineer the world had produced. The businesslike, just, and kind treatment they had always received from the Board went a long way towards securing for the shareholders the satisfactory results that were obtained. With regard to the outlook, as the Chairman had said, trade in India, and especially in Bombay, during the last few months had been bad. There had been an undoubted slump. The great mill industry had gone on to half time. It was a big exporting city; and the exports were bad. These two factors were detrimental for the moment to the maintenance of the rate of progress to which the Company had been accustomed during the past few years. But personally he was optimistic, and felt quite sure Mr. Burch was the same. The pendulum would swing, and good reports would again come along. They had a loyal staff, and the workmen were to-day contented, which was not the case with many companies employing men out there. There was a great deal of the labour agitator to be met with in India; and he was a very active man. But he thought the Company themselves had floored him. There was no gas-workers' union, and if they could help it they did not intend to have one. The Company had a first-class property, and the Board were keeping it well up to date; but extension work in the future, he was afraid, would be very heavy. The development schemes were progressing rapidly.

The proceedings concluded with a vote of thanks to the Chairman and Directors.

HONG KONG AND CHINA GAS COMPANY, LTD.

The Annual General Meeting of the Company was held on the 3rd inst., at the London Offices, No. 148, Gresham House, E.C.—Mr. A. F. Phillips (the Chairman) presiding.

The Secretary (Mr. A. C. Pullen) read the notice convening the meeting; and the Directors' report [*ante*, p. 302] and the statement of accounts were taken as read.

The Chairman said he regretted that the sales of gas at Hong Kong again showed a diminution, though slight; but the current year would no doubt reveal a better condition of things. The Company had continued to spend considerable capital on cookers and geysers; and he was pleased to say that the public lighting contract had been renewed—the old burners being changed to twin-light inverted fittings of greater power and efficiency. At Kowloon the sales increased by 3⅓ million c.ft.; and no doubt when the new holder came into use—as it should in a day or two—sales on that side would further enhance. The capital account showed an addition of £7435, of which £5560 was in connection with the new Kowloon holder. The satisfactory feature of the year's working was the reduction in the cost of coal by $45,000. The full benefit of the very favourable contract for 1922 was not felt in that year, owing to the highly priced stocks. The cost under this head during 1923 would show a further large decline. The amount received for gas rental was practically the same as before; the smaller sales at Hong Kong negativing the larger business at Kowloon. The balance of net revenue was £47,776; and a dividend for the year of 10 p.ct. (less income-tax) was recommended. One of the members of the Board, Mr. Robert H. Glen, had been in Hong Kong on the Company's business, and was accompanied by an independent technical adviser. The Directors considered that it was necessary for a thorough investigation to be made into the Company's affairs locally—particularly in respect of the working results and the falling-off in the business at Hong Kong. They felt that they could not continue to spend money on fitting houses with piping, meters, cookers, geysers, &c., without good reason for believing that the expenditure would be properly recouped. The Board in the past had adopted a policy of conserving financially, and felt very strongly that the Company should be feeling the benefit of this policy. The results for the previous two or three years had been a source of great disappointment to the Directors; but they were now again travelling along the road to prosperity. He mentioned at the last meeting that they had received an offer from a syndicate in Hong Kong to purchase the business, and that the Directors considered the terms offered were inadequate. They had since received a further offer, which was under most careful consideration. They had only just had definite news of this by cable, and must wait particulars, which were in the post. The Directors would not fail to inform the proprietors in due course, if in their considered judgment it was well to put the matter to the shareholders; but he would emphasize that the Company's position was really a very strong one. They had just sold some land at Hong Kong at a very high price, the proceeds of which would enable them to pay off all debentures, and hold £20,000 in hand for pushing trade. The values of their properties were very high. Further, they were able to pay a 10 p.ct. dividend for 1922 out of the profits for the year, and future prospects were very good. Such a matter as parting with the undertaking therefore required very serious deliberation. There had recently been a considerable demand for the Company's shares, and the market value had gone up considerably. To-day they were quoted at £14. He advised shareholders not to part with their shares without consideration and consulting the Secretary. In conclusion, he moved that the report and accounts be received and adopted.

In reply to an inquiry, the Chairman stated that the independent technical adviser accompanying Mr. Glen to Hong Kong was Mr. S. B. Johnson, the Manager of the Colombo Gas-Works, whom he considered a very good engineer.

The motion was carried unanimously, and the dividend recommended was declared.

The Directors, officers, and staff were heartily thanked for their services.

At a meeting of the Accrington and District Gas Board, Alderman Dewhurst expressed regret that Alderman Bury had stated that electricity was cheaper than gas for street lighting. Mr. A. J. Harrison (the Gas Manager) said the Gas Board were not responsible for the public lighting in Accrington and Church. They only supplied gas. He would be sorry if they had anything to do with the public lighting in Accrington beyond supplying the gas, having regard to the disgraceful state of that lighting. He said emphatically that gas was not having a proper chance in Accrington. In a fair candle-power test, electricity was not in it with gas for street lighting, in regard to cost. Gas gave them better lighted streets and better diffusion.

TONBRIDGE IDEAL HOMES EXHIBITION.

The Tonbridge Ideal Homes Exhibition, organized on behalf of the local hospital, was held at the Tonbridge Rink from April 30 to May 5. There was no lack of exhibitors, every available foot of space being occupied by some firm or another anxious to display its wares to the best advantage. Needless to say, a wide range of goods was shown, from a completely furnished bungalow to the smallest articles.

Prominent among these exhibits was that of the Tonbridge Gas Company. Considering the restricted space at their disposal, those responsible for this exhibit are to be congratulated on the manner in which the stand was set out. Every variety of gas cooking and heating stove was displayed to the best possible advantage, without any undue crowding, and without any one exhibit being obscured by another. The fireplace, fitted with a Main "Chaucer" gas interior in armour bright, was particularly noticeable, by reason of the handsome mahogany overmantel that surrounded it. Other gas-fires shown were the "Bronte," "Sheridan," "Gibbon," "Sterne," and further examples of the Main "Author" series.

A pleasing feature of the exhibit was the demonstration of the working of a gas-iron. This was carried out by a young lady who, while engaged in ironing a variety of articles, was always on the alert to show visitors the many advantages of a gas-iron, and the manner in which even the most delicate article could be ironed with ease and safety provided the gas-iron was used. Of the cookers, the ones that attracted most attention were the two well-known Main lines—the "Maintenance" and the "Mainstay." The visitors were particularly interested in the design of the "Ace" burner, and in the facilities for cleaning afforded by these two cookers.

An interesting selection of geysers, wash boilers, grillers, hotplates, and similar articles was also to be seen; nor were the advantages of gas for lighting overlooked. Wall-brackets, pendants, reading lamps, and pedestals, all fitted with silk shades of different designs and colours, gave a very pleasing effect; while the pneumatic switches controlling them showed conclusively that gas for lighting could be used with as much convenience as electricity. A gas illuminated flash-sign—the "Flashomotor"—bearing the words "Cook and heat by gas," also attracted much notice.

Each afternoon, gas cookery lessons and demonstrations were conducted by Miss Anstice M. Strick. The dishes, all of which were prepared in a "Maintenance" cooker, provided some dainty and appetizing specimens of the culinary expert's art. All proceeds resulting from the sale of these dishes among the visitors were afterwards handed over to the hospital funds.

Mr. James Donaldson (the Gas Company's Engineer) and his fellow-workers deserve the highest praise for the manner in which the exhibit as a whole was organized.

BURT, BOULTON, & HAYWOOD, LTD.

In the financial columns of "The Times" and in the financial daily papers of May 3, there appeared a statement giving particulars about the well-known and old-established firm of coal tar distillers, creosoters, and timber importers, Messrs. Burt, Boulton, & Haywood, Ltd. Of the authorized share capital of £500,000, £403,503 has been issued. Reserve and depreciation funds amount to nearly £300,000.

They have tar works at Silvertown (London), Port Tennant (Swansea), Selzaete (Belgium), Latresne (France), and Bilbao (Spain); and timber works at Grimsby, Eling (near Southampton), West Hartlepool, Barrow-in-Furness, Newport (Mon.), Silvertown, Rotherhithe, and Selzaete (Belgium). Their offices are situated in London and Paris.

Both in England and on the Continent the Company have been pioneers in the co-operative movement between the producers and the distillers of tar. Various organizations now operating under the Company's management in the London district, in the Southern and Western Counties, in South Wales, and in Belgium, testify to the success of this policy. In addition to the important chemical, disinfectant, creosoting, and timber business carried on at their various works, the Company are also engaged in the coal and cement trades; and of recent years a wharfage and warehouse business has been successfully inaugurated.

Messrs. Burt, Boulton, & Haywood, Ltd., either founded or have a predominant interest in the Dominion Tar and Chemical Company, Ltd., the Canada Creosoting Company, Ltd., the British Nigerian Timber Company, Ltd., the Kenya Creosoting Company, Ltd., and the British Australian Timber Company, Ltd.

Schemes affecting the welfare of the Company's employees have been established in recent years, and experience points to the fact that the existence of the profit-sharing and investment schemes, the staff endowment assurance scheme, the Athletic Club, and the House Magazine, not only make for greater harmony in the management, but perhaps anticipate a demand which may be made by far-seeing investors in future years.

Irish Gas Undertakings.—The Drogheda Gas Department is refunding to the Corporation a sum of £1800, being the balance of £3600 which was raised by way of rate in the year 1920-21 to cover a deficiency in the department's revenue. For the year ended March last, the Lurgan Urban Council Gas-Works receipts were £27,520; the expenditure amounting to £25,374.

Auction Sale of Gas Stock.—At Messrs. A. & W. Richards' auction sale last week, the following prices were realized: Wandsworth, Wimbledon, and Epsom District Gas Company.—"Wimbledon" stock, £112 p.ct.; new ordinary stock, £101½ to £103 p.ct. South Suburban Gas Company.—Ordinary stock, £102½ p.ct.; debenture stock, £102 p.ct. Tottenham District Light, Heat, and Power Company.—Debenture stock, £82 p.ct.; "B" stock, £105 to £106½ p.ct. Gas Light and Coke Company.—Ordinary stock, par. Herne Bay Gas Company.—Original shares, £8 2s. 6d. per share; additional shares, £5 12s. 6d. per share. Southend Gas Company.—"B" stock, £90½ to £91 p.ct.

THE NORTH-EAST COAST COAL TRADE.

From Our Own Correspondent.

The market has remained firm and unchanged during the past week. The demand for prompt and for June shipment is still in excess of available supplies, and recent prices for all descriptions appear likely to be maintained. When boats are not fully stemmed, merchants have the greatest difficulty in finding coal to make up their cargoes.

Coking coal remains the best market, both for prompt and for the second half-year. Steams are rather uncertain. The market is said to be all sold up to the end of June, which keeps the price firm at about 35s. for best qualities, in spite of serious competition from Wales and Yorkshire. If trade relations with Russia are broken off, it is said that considerable quantities of steams will be thrown back on this market which have been sold over the rest of the year to the Soviet Government.

Business beyond the end of June is far from brisk, with collieries still not anxious to dispose of their available balances at figures which would tempt many buyers. However, there have been several pointers during the week, which give a good idea of the underlying strength of the market. Coking coal has been sold for July-September at 35s. f.o.b., and for July-December there have been several considerable transactions at 32s. 6d. It was reported last week that best gas had been sold at 28s. for July-June, and this price for the twelve months has probably been repeated, while seconds have been done for the same period at 27s. f.o.b. Such prices certainly indicate that in sane quarters the effects of the present situation are likely to affect the position some way ahead.

Current quotations for gas coal are 35s. for Wear specials and best qualities, and 32s. 6d. for seconds; but supplies are practically unobtainable up to the end of June.

YORKSHIRE AND LANCASHIRE COAL TRADE.

From a Local Correspondent.

Gas coal in Yorkshire and Lancashire is moving slowly for inland purposes; though there is a good demand for this description of fuel for export. There does not appear to be any likelihood of a reduction in the inland price; and consumers may be recommended to make their purchases over the winter as soon as possible.

The export market continues in activity, and large quantities of all descriptions of fuel are being booked ahead for shipment to Belgium and to Germany. The general uncertainty of the Ruhr position, and the fact that producers have large order books make the present situation in regard to household coal for the home market of no importance. The foreign market will take the surplus of house coal created by the warmer weather. During April, 365,027 tons of coal were shipped from Hull to foreign countries, an increase of 186,835 tons as compared with April last year. The foreign export this year up to April 30 from this port was 1,323,613 tons, an average of 708,866 tons.

In Lancashire, the cotton trade is not taking as much coal as usual, but this is more than compensated for by the activity of shipping. All surplus fuel is going away, and in some cases there is a scarcity.

COAL TRADE IN THE MIDLANDS.

From Our Local Correspondent.

A few more contracts have been made by gas undertakings for next year's supplies. The number is very small, however—buyers preferring in the great majority of cases to postpone decisive negotiations till the latest possible moment. Yorkshire collieries are firm in their demands for better prices than those named in the expiring contracts. The minimum advance which they ask is 1s. 6d., and in many cases 2s. 6d. is required. This is the basis on which discussion of fresh commitments is proceeding; and where contracts have been concluded, buyers have had to go a long way to meet sellers. Derbyshire collieries put their demands on much the same level; but there is a strong demur. A feature of the market is the stringency in regard to gas nuts. Several causes seemed to have contributed to this; and it may be that a proximate one is to be found in the changing economy of gas manufacture. It is certain that managements are substituting nuts for screened coal in their specifications, not to any great extent, but in appreciable quantities. Another contributory factor is the crushing of nuts for coke, and the third is the export demand. There is a falling off in the sales of domestic coal with the advance of the season. One Black Country colliery has reduced its price by 1s. 6d. Works fuel is being well taken up in the Birmingham district; but more generally there is a note of hesitancy, which may be due to the approach of Whitsuntide. Furnace coke prices are as stiff as ever; but gas coke is easier.

Satisfactory Portsmouth Gas Tests.—The report of the Chief Inspector of Weights and Measures for the year ended March 31, submitted by the Finance Committee to the Portsmouth Council, was generally satisfactory. As to the supply of the Portsea Island Gas Light Company, the statement was as follows: 417 tests have been made for the calorific value of gas; and the mean for the year was 453·391 B.Th.U.—rather more than three units over the prescribed standard. During one month only was the mean below the standard, and then the deficiency was less than one unit; so that on the whole the consumer has received rather more than he has paid for in the matter of heat value. With regard to the general character of the gas, the results compare very favourably indeed with those reported from other towns. Sulphuretted hydrogen has been practically absent—scarcely a trace has been found; and carbon monoxide, though not a recognized impurity, has been lower than in most places where a mixed gas is supplied. Alderman Sir Harold Pink remarked that the report was one of the best that had been placed before the Council.

TRADE NOTES.

Meldrum's Centrifugal Gas-Scrubber.

Messrs. Meldrums, Ltd., of Timperley, near Manchester, have now secured a further order for three of their new centrifugal gas-scrubbers, each of a capacity of five million c.ft. per twenty-four hours.

Koppers Regenerative Reversing Setting.

Messrs. King, Taudevin, & Gregson, Ltd., of Melbourne Chambers, Cambridge Street, Sheffield, have secured the sole licence in Great Britain and Ireland for the building of Koppers regenerative reversing settings for horizontal, vertical, and inclined retorts and chamber ovens, for gas-making plants; also central producer plant in connection with same, designed to gasify a large proportion of small breeze and coke dust.

W. J. Jenkins and Co.'s Stoking Machines, &c.

Messrs. W. J. Jenkins and Co., Ltd., of Retford, have recently received orders for their latest type stoking machines, coal and coke handling plant, and bench mountings for the new horizontal house of the Cambridge University and Town Gas Light Company; also for two combined machines for the new horizontal house of the Birkenhead Corporation Gas Department. The machines are similar to the one described in our issue of May 2 [*ante*, p. 273].

Automatic Lamp-Lighters.

Alderman Hindle informed the Darwen Town Council that the automatic lamp-lighters had justified their introduction, having effected a saving of £1500 on public lighting. It was stated that the profit of the gas department for the year amounted to £4183. They had already reduced the price 6d. per 1000 c.ft.; and it was proposed to bring down the charge to 4s. by a further reduction of 4d. We are informed that the complete installation of 1000 controllers was supplied by the Horstmann Gear Company, Ltd., Newbridge Works, Bath. "Newbridge" controllers were selected after tests of various other makes; and the saving effected has, it will be seen, amounted to 30s. per lamp on the winter season.

CURRENT SALES OF GAS PRODUCTS.

The London Market for Tar, Tar Products, and Sulphate.

LONDON, *May* 14.

There is no change to report in the London market for pitch. In the absence of further business for this season's shipment, the price is nominal. Tar for roads continues in strong demand. Creosote is steady at about 10d. to 10½d. per gallon. Tar spirits are quiet; 95/160 solvent naphtha being about 2s. per gallon, pure benzole about 1s. 8d. per gallon, and pure toluole from 2s. to 2s. 3d. per gallon. Other products are without alteration.

Tar Products in the Provinces.

May 14.

The average values for gas-works products during last week were: Gas-works coal tar, 99s. to 104s. Pitch, East Coast, 160s. to 162s. 6d. f.o.b. West Coast—Manchester, 157s. 6d. to 160s.; Liverpool, 160s. to 163s 6d.; Clyde, 162s. 6d. to 165s. Benzole 90 p.c., North, 1s. 6d. to 1s. 6½d.; crude 65 p.ct. at 120° C., 1s. to 1s. 0½d. naked at makers' works; 50-90 p.ct., naked, North, 1s. 8d. to 1s. 8½d. Toluole, naked, North, 1s. 11d. to 2s. nominal. Coal tar crude naphtha in bulk, North, 8½d. to 9d. Solvent naphtha, naked, North, 1s. 8d. to 1s. 10d. Heavy naphtha, North, 1s. 6d. to 1s. 8d. Creosote, in bulk, North, liquid, 8½d. to 8¾d.; salty, 7¾d. to 8d. Scotland, 7d. to 7½d. Heavy oils, in bulk, North, 9d. to 9½d. Carbolic acid, 60 p.ct., 3s. 9d. to 3s. 10d. prompt. Naphthalene, £15 to £16; salts, £6 to £8, bags included. Anthracene, "A" quality, 4d. per minimum 40 p.ct., purely nominal; "B" unsaleable.

A Successful Year at Stratford-on-Avon.

The local press reports that the Gas Department of Stratford-upon-Avon have had a successful year. At the Council meeting held on the 8th inst., Alderman Ballance, in moving the confirmation of the minutes, stated that the make of gas was 94 million c.ft., and greater than it had ever been before. Leakage had been reduced from 9·5 to 6·6 p.ct.; and this meant a saving of several hundred pounds. The vertical retorts had worked satisfactorily; and the gas had been of good quality and economically produced. The sulphate of ammonia returns were the highest in the history of the undertaking. Considerable extensions had taken place during the past year. The net profit for the year was £2692. It was proposed to hand over £700 for the relief of the rates, and to write-off £1500 on suspense account. The latter account had been built-up some years ago; and difficulty was experienced in obtaining a loan, owing to war conditions. The price of gas was recommended to be reduced by 6d. per 1000 c.ft., and the discount increased from 2½ to 5 p.ct. Power rates are to be reduced as under: Up to 50,000 c.ft., 1d. per 1000 c.ft. reduction; up to 100,000 c.ft., 2d. reduction; and over 100,000 c.ft., 3d. reduction. An outlying district which had not previously benefited would participate in the 5 p.ct. discount. The Chairman mentioned that Mr. Frederick Shewring, their Engineer and Manager, had been with them two years; and the Committee unanimously recommended that his salary be increased by £112 per annum. The minutes were passed by the Council.

Suggested Irish Reforms.—The Irish Free State Government announce that they are considering the establishment of a Patents Office. The Senate have urged the Government to appoint a Committee with a view to the adoption of the metric system.

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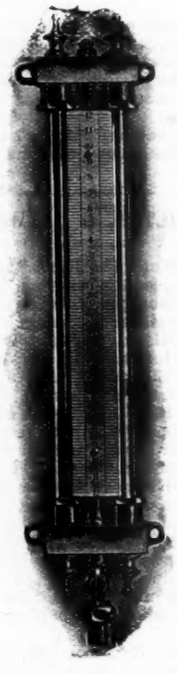

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STOCK MARKET REPORT.

THE Stock Exchange has had a very dull week from the start; almost every market being a sufferer. The gilt-edged was among the first to feel it, and on Monday began its course downward. Home Rails were quick to follow, and the Foreign Market weakened. On Wednesday, heavy selling of high-class securities dragged others down with them. This continued on Thursday, and depression continued to the close on Friday.

The Gas Market, as usual, exhibited its exemption from these adverse influences, and had a bright and busy week, illustrated by a score or more of advanced quotations, and not one lowered. In the London Companies, Gas Light ordinary and maximum were higher. In the Suburban and Provincial group, Alliance and Dublin rose 1, Bournemouth preference ¼, ditto debenture 4, Brentford "B" 2, Cardiff debenture 2, Croydon sliding-scale 2, Newcastle 1½, ditto debenture 2½, all three Sheffields 1 each, South Shields 9, South Suburban 1, ditto debenture 2, Swansea debentures 1, and Wandsworth, Wimbledon 1. Continental Union and Imperial Continental rose 3 each.

The following transactions in gas during the week were recorded: On Monday, Bournemouth "B" 12 3/16, Brentford "B" 103, Commercial 4 p.ct. 99½, 99⅝, ditto 3 p.ct. debenture 60, 60½, European 9⅝, 9¾, Gas Light ordinary 99¾, 100, 100¼, 100⅜, 100½, 100¾, ditto 3½ p.ct. maximum 67½, ditto 4 p.ct. preference 81½, Imperial Continental 168½, Primitiva 9s. 6d., ditto 5 p.ct. preference 38s. 3d., 39s. 9d., South Metropolitan 99⅞, 100, 100¼, 100½, 101, South Suburban 100½, Tottenham "B" 105, Wandsworth "C" 103, Hornsey 4 p.ct. debenture 76½, Uxbridge, Wycombe and District 4 p.ct. debenture 79½, Wandsworth 4 p.ct. debenture 81⅜, 81¾. On Tuesday, Alliance and Dublin 67 11/16, Bournemouth 5 p.ct. 11⅛, 11¼, ditto "B" 11 1/16, 11 1/16, ditto 6 p.ct. preference 10⅞, 11, Brighton and Hove "A" ordinary 133, Bristol 93½, 94, Commercial 4 p.ct. 98½, ditto 3½ p.ct. 98½, ditto 3 p.ct. debenture 58½, Continental Union 29¾, Croydon sliding-scale 102, European 9 15/16, Gas Light ordinary 100¼, 100⅜, 100½, 100⅝, 100¾, ditto 3½ p.ct. maximum 67½, ditto 3 p.ct. debenture 63⅜, Hong Kong 15½, Imperial Continental 167, 169, 170, 171½, ditto 3½ p.ct. debenture 76½, Oriental 99, Primitiva 5 p.ct. preference 39s. 3d., Sheffield "B" 95⅝, 96¼, South Metropolitan 99⅜, 100, 100½, 100⅝, South Suburban 100⅜, 102, Tottenham "B" 105½, Wandsworth new 102½, ditto 4 p.ct. debenture 81⅜, Hornsey 10 p.ct. 197½, 198, ditto 4 p.ct. debenture 78, Tottenham 6 p.ct. mortgage 100. On Wednesday, Brentford "A" 103, British "A" ordinary 12⅜, 12 13/16, ditto "B" 11 7/8, Commercial 3½ p.ct. 98, ditto 3 p.ct. debenture 59, Gas Light ordinary 100, 100⅛, 100½, 100¾, 100⅞, Hornsey 148, 150, Imperial Continental 170, Primitiva 5 p.ct. preference 38s., South Metropolitan 99½, 99⅝, 99¾, 100, Tottenham "B" 104½, Wandsworth, Wimbledon 114, Reading 5 p.ct. maximum ordinary 74½, 75, South Suburban 7 p.ct. debenture 103, Southgate and District 5 p.ct. preference 97½. On Thursday, Alliance and Dublin 67¼, Brentford "A" 102½, 103, Brighton and Hove original 177, ditto "A" ordinary 133, Cardiff 7½ p.ct. debenture 112, 112½, Commercial 3½ p.ct. 98⅛, Continental Union 31, 32½, Croydon sliding scale 105, Gas Light ordinary 100, 100⅛, 100¼, 100⅜, 100½, 100⅝, ditto 3½ p.ct. maximum 67½, 67⅝, ditto 4 p.ct. preference 83, ditto 3 p.ct. debenture 63½, Imperial Continental 169, 170¼, 171, ditto 3½ p.ct. debenture 77¼, 78, Lea Bridge 101, Newcastle 87½, North Middlesex 12 5/16, Primitiva 9s. 6d., ditto 5 p.ct. preference 38s., South Metropolitan 99, 100, 100¼, 100⅝, 100⅞, ditto 6½ p.ct. debenture 106½, South Suburban 101, 102, Barnet "C" 159½, 160, Brighton and Hove 4 p.ct. preference 75, ditto 4 p.ct. debenture 76, North Middlesex 5 p.ct. preference 93½, Southgate and District 7 p.ct. maximum 102, 105, ditto 5 p.ct. preference 97, ditto 7½ p.ct. debenture 105, Tottenham 6 p.ct. mort. 100, 100½. On Friday, Alliance and Dublin 67⅜, 67½, Bournemouth 4 p.ct. debenture 76, Brentford "B" 102¾, Brighton and Hove original 179, ditto "A" ordinary 135, British "A" 13¼, ditto "B" 12½, 12¾, Cape Town debenture 77, Continental Union 31½, Gas Light ordinary 100, 100⅛, 100⅛, 100½, 100⅝, ditto 3½ p.ct. maximum 68, 68¼, ditto 4 p.ct. preference 82½, 83, ditto 3 p.ct. debenture 64⅜, 65, Imperial Continental 170½, Monte Video 62½, Primitiva 9s., ditto 5 p.ct. preference 37s. 9d., South Metropolitan 99⅞, 100, ditto 3 p.ct. debenture 63¾, South Suburban 102½, Swansea 6½ p.ct. debenture 106½, 107, Tottenham "B" 105, ditto 7½ p.ct. mortgage 103, 105, Reading 5 p.ct. maximum 78½, Wolverhampton 8 p.ct. debenture 107⅞, 108¾.

The Money Market opened in great ease; the supply being abundant. But a marked change took place the next day; and the demand grew stronger almost daily and closed firm. Discount tightened. Silver eased. The Bank of England rate was 3 p.c., as fixed on July 13.

ANTE-WAR PRICES AND DIVIDENDS, LATEST DIVIDENDS, AND LAST WEEK'S TRANSACTIONS.

Issue.	Share.	When ex-Dividend.	Ante-War Dividend & Bonus.	Last Dividend.	NAME.	Closing Prices, July 30, 1914.	Present Prices.	Lowest and Highest Prices of Transactions.
£			p.c.					
131,978	Stk.	Feb. 22	—	5%	Aldershot 5 p.c. max. C.	..	71–79	...
190,492	,,	,,	4	4%	Do. 4 p.c. Pref.	..	70–75	...
1,551,868	,,	Apl. 5	2½	5%	Alliance & Dublin Ord.	59–64	66–71	67¼–70
374,000	,,	Jan. 11	4	4%	Do. 4 p.c. Deb.	76–79	60–65	...
280,000	5	Oct. 19	7½	4/–	Bombay, Ltd.	5⅛–6⅛	4⅜–5⅜	...
100,000	5	Feb. 22	16	8/–	Bournemouth Gas and Water: 5 p.c.	..	11–12	11⅛–11⅜
383,110	10	,,	7	7/–	Bournemouth Gas and Water: B 7 p.c.	15–15⅛	11⅛–12⅛	12 1/16–12 1/16
115,000	10	,,	6	6/–	Bournemouth Gas and Water: Pref. 6 p.c.	13¾–14	10⅜–11⅜	10⅜–11
162,065	—	Dec. 29	—	4%	Bournemouth Gas and Water: 4 p.c. Deb.	..	75–80	76
992,045	Stk.	Feb. 22	14	6/–	Brentford A Consolid.	261–266	102–107	102½–103
734,920	,,	,,	11	6/3	Do. B New	204–209	102–107	102¾–103
55,000	,,	,,	5	5%	Do. 5 p.c. Pref.	109–111	85–90	...
221,400	,,	Dec. 14	4	4%	Do. 4 p.c. Deb.	91–93	78–83	...
214,775	,,	Mar. 8	11¼	4%	Brighton & Hove Orig.	208–213	175–180	177–179
244,200	,,	,,	8	8¼%	Do. A Ord. Stk.	154–159	130–135	133–135
1,272,500	Stk.	Feb. 22	5	5%	Bristol 5 p.c. max.	..	92–95	93¼–94
570,000	20	Mar. 22	12½	10/–	British A Ord.	44–45	12⅛–13⅛	12⅛–13⅛
10,000	10	Dec. 29	—	7/–	Do. 7 p.c. Pref.	..	12–13	...
120,000	Stk.	June 29	4	4%	Do. 4 p.c. Deb. Stk.	88–90	75–80	...
220,335	,,	Dec. 29	4	4%	Buenos Aires 4 p.c. Deb.	85–87	55–58	...
100,000	10	Nov. 2	—	—	Cape Town & Dis., Ltd.	1½–2½	6½–7½	...
100,000	10	May 3	—	4/6	Do. 4½ p.c. Pref.	4–6	6–7*	...
100,000	Stk.	Dec. 29	4½	—	Do. 4½ p.c. Deb. Stk.	70–75	72–77	77
237,860	,,	,,	—	7½%	Cardiff 7½ p.c. Deb.	..	109–114	112–112½
157,150	,,	Feb. 26	5	5%	Chester 5 p.c. Ord.	108–110	..	...
1,513,280	,,	Mar. 8	5/9/4	60/–	Commercial 4 p.c. Stk.	106–108	97–100	98¼–99⅜
560,000	,,	,,	5½	60/–	Do. 3½ p.c. do.	103–105	97–100	98–98½
475,000	,,	Dec. 14	3	3%	Do. 3 p.c. Deb. Stk.	69¼–71¼	57–62	58¼–60½
800,000	,,	Dec. 15	4	—	Continental Union, Ltd.	76–79	30–35	29½–32½
200,000	,,	Dec. 14	7	4%	Do. 7 p.c. Pref.	115–118	57–62	...
660,000		Mar. 8	—	6%	Croydon sliding scale.	..	102–105	102–105
284,975		,,	—	5%	Do. max. div.	..	83–86	...
492,270	Stk.	,,	6	4½%	Derby Con. Stk.	123–125	..	...
55,000	,,	,,	4	4%	Do. Deb. Stk.	102–104	..	...
209,000	,,	Apl. 5	—	5%	East Hull 5 p.c. max.	..	..	...
1,002,180	10	Jan. 25	10	5/0	European, Ltd.	17½–18	9¼–10½	9½–9 15/16
16,546,120	Stk.	Feb. 8	4/17/4	52/–	Gas Light & Coke: 4 p.c. Ord.	98–102	99½–101½	99½–100⅝
2,600,000	,,	,,	3½	35/–	Gas Light & Coke: 3½ p.c. max.	76–79	67–69	67½–68½
4,062,235	,,	,,	4	4%	Gas Light & Coke: 4 p.c. Con. Pref.	96–99	81–83	81½–83
4,761,930	,,	Dec. 14	3	3%	Gas Light & Coke: 3 p.c. Con. Deb.	72½–74½	62–65	63½–65
130,000	,,	Dec. 11	10	10%	Gas Light & Coke: 10 p.c. Bonds	..	..	...
—	—	—	—	—	Gas Light & Coke: 7½ p.c. Ilford Deb.	..	..	...
82,500	,,	Mar. 8	5	65/7½	Hastings & St. L. 5 p.c.	..	92–97	...
258,740	,,	,,	3½	50/7½	Do. 3½ p.c.	87–89	75–78	...
70,000	10	May 18	11	10%	Hongkong & China, Ltd.	16½–16¾	14–16	15½
86,600	Stk.	Mar. 8	9	9½%	Hornsey 7 p.c.	..	147–152	148–150
1,976,000	,,	Nov. 16	9	£5	Imperial Continental	150–160	168–173	167–171½
404,800	,,	Feb. 8	3½	3½%	Do. 3½ p.c. Deb. Red.	84–86	75–78	76½–78
235,242	,,	Mar. 8	6½	6½%	Lea Bridge Ord. 5 p.c.	119–121	93–98	101
2,498,905	,,	Feb. 26	10	37/6	Liverpool 5 p.c. Ord.	..	..	...
600,000	,,	Mar. 22	—	7%	Liverpool 7 p.c. Pref.	..	103–105	...
165,736	,,	Feb. 22	7/5/6	80/–	Maidstone 5 p.c.	..	107–112	...
63,480	,,	Dec. 29	—	3%	Do. 3 p.c. Deb.	..	53–58	...
75,000	5	June 29	6	6%	Malta & Mediterranean Met. of Melbourne: 4½ p.c. Deb.	4⅛–4½	3½–4⅛	...
100,000	100	Apl. 5	4½	4½%		99–101	97–100	...
341,920	Stk.	Nov. 30	4	4%	Monte Video, Ltd.	11½–12	60–65	62½
1,875,892	,,	Feb. 22	4½	5¼%	Newcastle & Gatsh'd Con.	98¼–99¼	87–88	87½
250,166	,,	,,	—	4%	Do. 4 p.c. Pref. Stk.	..	76–78	...
329,705	,,	Dec. 29	3½	3½%	Do. 3½ p.c. Deb.	82–83	70–72	...
15,000	10	Aug. 26	—	7/6	North Middlesex 10 p.c.	..	..	12 5/16
55,940	10	Mar. 8	7/14/0	7/8⅝	,, ,, 7 p.c.	14–15	12–13	...
300,000	Stk.	May 3	8	8%	Oriental, Ltd.	117–122	97–102*	99
188,120	Stk.	Dec. 29	—	72/6	Plym'th & Stonh'se 5 p.c.	..	100–105	...
60,000	50	Mar. 8	13	65/–	Portsea Island, B	128–131	103–108	...
100,000	50	,,	12	60/–	Do. C	118–121	100–105	...
290,069	5	,,	8	—	Primitiva Ord.	5⅛–6	⅛–⅜	9/–9/6
499,960	5	—	5	—	Do. 5 p.c. Pref.	4⅛–5	1¼–2¼	37/9–39/9
521,600	100	Nov. 30	4	4%	Do. 4 p.c. Deb.	91–93	70–73	...
600,000	Stk.	Jan. 25	4	4%	Do. ,, ,, 1911	..	55–58	...
346,198	,,	Dec. 29	4	4%	River Plate 4 p.c. Deb.	85–87	55–58	...
150,000	10	Mar. 22	6	6/–	San Paulo: 6 p.c. Pref.	10¼–11	5⅜–6	...
125,000	50	July 3	5	5%	San Paulo: 5 p.c. Deb.	47–49	38–41	...
135,000	Stk.	Mar. 22	10	5%	Sheffield A	223–224	97–99	...
209,984	,,	,,	10	5%	Do. B	222–224	97–99	95¼–96¼
525,500	,,	,,	10	5%	Do. C	220–222	97–99	...
133,201	Stk.	Sept. 15	4	4%	Shrewsbury 5 p.c.	..	..	...
90,000	10	Nov. 2	9	7%	South African	10¼–11½	7–9	...
6,609,895	Stk.	Feb. 22	5/4/0	60/–	South Met. Ord.	111–113	99–102	99–101
250,000	,,	Jan. 11	—	5%	Do. Red. Pref.	..	97–99	...
1,895,445	,,	,,	3	3%	Do. 3 p.c. Deb.	72½–74½	62–64	63¼
734,000	,,	Mar. 8	—	6½%	Do. 6½ p.c. Deb.	..	105–107	106½
91,500	,,	Feb. 22	8½	8½%	South Shields Con. Stk.	157–159	124–126	...
1,087,795	,,	,,	6	6%	S'th Suburb'n Ord. 5 p.c.	114–116	100–103	100¼–102½
368,837	,,	Dec. 29	5	5%	Do. 5 p.c. Deb. Stk.	116–118	93–98	...
647,740	,,	May 3	5	7%†	Southampton Ord.	99–102	88–91*	...
121,275	,,	Dec. 29	4	4%	Do. 4 p.c. Deb. Stk.	..	68–73	...
250,000	,,	Mar. 8	—	7½%	Swansea 7 p.c. Pref. Stk.	..	102½–104½	...
200,000	,,	Dec. 29	—	6½%	Do. 6½ p.c. Deb. Stk.	..	100–108	105½–107
120,000	,,	Feb. 22	—	7½%	Tottenham District: A 5 p.c.	135–138	123–128	...
782,275	,,	,,	6	6%	Tottenham District: B 3½ p.c.	115–117	102–107	104½–105½
181,255	,,	Dec. 14	4	4%	Tottenham District: 4 p.c. Deb.	87–89	75–80	...
858,251	Stk.	Mar. 22	5	5%	Tynemouth 5 p.c. max.	108½–109	90–92	...
—	—	—	—	—	Wandsworth, Wimbledon, and Epsom—	—	—	—
30,000	,,	Feb. 22	8½	87/6	Wandsworth A 5 p.c.	151–156	130–135	...
255,636	,,	,,	6½	72/6	Do. B 3½ p.c.	129–134	115–120	...
108,075	,,	,,	—	61/3	Do. C.	..	100–105	103
140,865	,,	,,	—	61/3	New Ordinary	..	100–105	102½
352,000	,,	,,	6½	68/9	Wimbledon 5 p.c.	117–122	110–115	114
98,000	,,	,,	6½	73/9	Epsom 5 p.c.	131–136	115–120	...
88,426	,,	Dec. 29	3	3%	5 p.c Deb. Stk.	66–69	58–61	...

* Ex. div. † Including back dividend.

The British Gas Light Stock Prices.

Sir,—With reference to the letter on this subject in your issue of the 9th inst., I would observe that the table of figures appended to the Stock Market report professes to record only the various conditions obtaining on July 30, 1914, when the war began, and those existing at the close of the week preceding the date of each number of the "JOURNAL." Intermediate changes (some of them of great magnitude, *vide* Brentford and Sheffield as examples) cannot possibly be set forth, if only for lack of space, and they might very probably be "misleading" to anyone unfamiliar with the financial administration of a gas company.

YOUR STOCK MARKET CORRESPONDENT.
May 10, 1923.

Stockton and the Gas Regulation Act.

The Thornaby-on-Tees Corporation have decided to withdraw opposition to the application of the Stockton Corporation for an Order under the Gas Regulation Act. The conditions upon which this decision was arrived at were reported to the Thornaby Council as follows: (1) So long as the Stockton Corporation supply gas within the borough of Thornaby, the charge and the conditions on which the gas is supplied to be the same to consumers in Thornaby as in Stockton. (2) The Thornaby Corporation will withdraw their objection to a maximum price of 14d. per therm on condition that the Stockton Corporation agree not to charge a higher price than is reasonable. (3) It is understood that the acceptance of the maximum price by the Thornaby Corporation is not to be used as an argument that they consider it to be a fair and reasonable one; nor is it to preclude the Thornaby Corporation from asking for a revision of the charge at any future time. (4) A pressure gauge, as prescribed by the Gas Referees, for testing the pressure of the gas supplied is to be installed and maintained at the Town Hall, Thornaby, at the cost of the Stockton Corporation; the Thornaby Corporation to have proper facilities for making tests and for testing the accuracy of the apparatus at any time. (5) The Stockton Corporation are to instal at such place as the Gas Referees shall prescribe a constant recording calorimeter for testing and recording the calorific value of the gas supplied by them during the whole of the 24 hours of every day; the calorimeter to be open to inspection and examination by a duly appointed official of the Thornaby Corporation at any time during the day, or by appointment during the night. He is to be at liberty to take tests both as to the calorific value of the gas and the accuracy of the calorimeter. It was decided to discuss the question of the appointment of a gas examiner at the next meeting.

Ellesmere Gas-Works Profit.—It was reported to the Ellesmere Urban Council last week that there was a profit on the gas undertaking on the year's working of £280. There was an increase of 1,930,400 c.ft. of gas used last year, as compared with the previous year. The Clerk stated that the whole question of charges would be considered when the expert made his report on the gas-works.

Sunderland Price Reduction.—The Sunderland Gas Company again have reduced the price of gas by 3d. per 1000 c.ft., making the present cost 2s. 3d. for lighting, heating, and cooking, and 2s. 1d. for power, less discount in both cases. These prices are only 23 p.ct. above the Company's pre-war figure of 1s. 10d. per 1000 c.ft. The price is now equivalent to 5·2d. per therm net. The reduction dates from the last readings of the meters in February and March. The Company are enabled to make the reductions through good coal contracts and a good market for residuals. A total reduction has been made since November, 1921, of 1s. 9d. per 1000 c.ft.

Nottingham Street Lighting.—Though some notable improvements have in recent years been effected in regard to the matter in the central areas of the city, dissatisfaction still is rife in Nottingham as to the inadequate illumination of many thoroughfares. Archaic arrangements which formerly obtained in the market place and in the neighbourhood of the railway stations have been displaced by up-to-date plans, but there is need of a standardizing process generally in relation to public lamps. The subject was again brought to the notice of the Corporation at a meeting on Monday last, when a resolution, submitted by Mr. W. E. Walker, was agreed to appointing a special committee of three representatives each of the Gas Committee and the Electricity Committee, and three of the Council who are members of neither Committee, to inquire into the system of street lighting at present in operation, and to consider whether any, and if so what, alteration is desirable. As to the necessity for a drastic change, it is doubtful, in the view of those conversant with unsatisfactory local arrangements, whether there can be any justification for diversity of opinion. Nottingham may, it is felt, take a lesson with advantage from one or two not far distant Midland towns where matters in regard to public lighting have been managed with much greater effectiveness.

Gas-Workers' Wages at Barrow.—At the Barrow Town Council meeting on Monday, May 7, the Gas and Water Committee reported that the Manager had submitted a revised sliding-scale agreement regarding workmen's wages adopted by the National Joint Industrial Council for the Gas Industry in July last, which the Works Joint Committee had considered and recommended be adopted. Further, that the Joint Committee also recommended that the following reductions be made from April 9 in the rates of pay of gas workers: Day workers, ½d. per hour; shift workers, 4d. per shift for six shifts in each week, and ½d. per hour for overtime. The Council approved the recommendations.

London County Council and the Gas-Main Conference.—The General Purposes Committee of the London County Council reported fully on May 1 [*ante*, p. 299] as to the proceedings at the recent conference, at which the Council were represented, convened by the Board of Trade, of representatives of local authorities and of gas undertakings, to consider the steps to be taken to lessen the dangers arising from the use of gas. The Council approved certain suggestions which were adopted by the conference; and in view of the fact that the whole question is now under consideration by the Board, the Public Control Committee say that no useful purpose would appear to be served by their reporting at this juncture on the reference to them. They will, however, report further when the Board have decided as to what (if any) action shall be taken in the matter.

It was stated by Alderman Bury at a meeting of the Accrington Town Council that, following the introduction of controllers on street-lamps, the number of mantles broken per day had been reduced from 16 to 2·235.

Though they had to pay £18,650 for interest on money borrowed at the formation last year, the Radcliffe and Little Lever Gas Board report a profit of £2345. They have decided to reduce the price by just over 4d. per 1000 c.ft.

The Bradford Gas Committee recommend the Corporation to apply to the Unemployment Grants Committee for a grant towards the cost of laying a new gas-main in New Road and Huddersfield Road, Low Moor, at an estimated cost of £1165. The Finance Advisory Committee have approved of the proposal.

A large gathering of members of the local Chamber of Commerce followed with keen interest, at a recent meeting, a lecture on "Gas and Its History," by Mr. F. Southgate, Manager of the Hythe Branch of the Folkestone Gas and Coke Company. In a chatty manner he told all about Murdoch and his discoveries, and explained the therm. He also referred to the many advantages of gas, and concluded by inviting his listeners to visit him at the works, where he would be pleased to go more fully into details, and give an ocular demonstration of the various processes involved.

The second annual report of the Joint Hon. Secretaries (Messrs. H. S. Bartlett and T. Noall) shows that the Cardiff Gas Company's Athletic and Social Club—of which Mr. George Clarry is President, and Mr. H. D. Madden Vice-President—has had a very successful year. Gratitude is expressed to the Directors and management of the Company, but for whose continued kind interest, thoughtfulness, and generosity, the Club would not be in its present happy condition. Football, hockey, cricket, tennis, and baseball teams have been active; and the Entertainments Committee organized a number of enjoyable social functions. It has been decided to organize a Sports Day at Grangetown during the summer. One of the most indefatigable members—Mr. Ernest H. Clarry—has resigned from the Company's service, and taken up an important appointment elsewhere. The Council have placed on record their keen appreciation of his splendid work for the Club, and have enrolled him as an honorary member. The membership roll is 790. At the annual meeting in the Grand Hotel, Cardiff, Mr. George Clarry, F.C.I.S., presided, and congratulated the Club upon its great activity and success, which he attributed to the spirit of comradeship that pervaded the members. A smoking concert followed, and during this a presentation of a gold medal was made to Mr. H. Evans, of the Company's Baseball Club, who was selected to captain the Welsh International team.

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